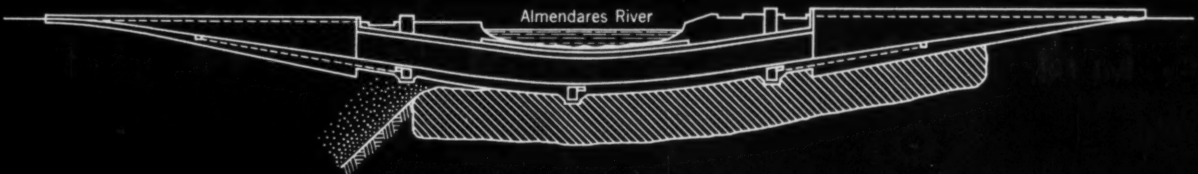
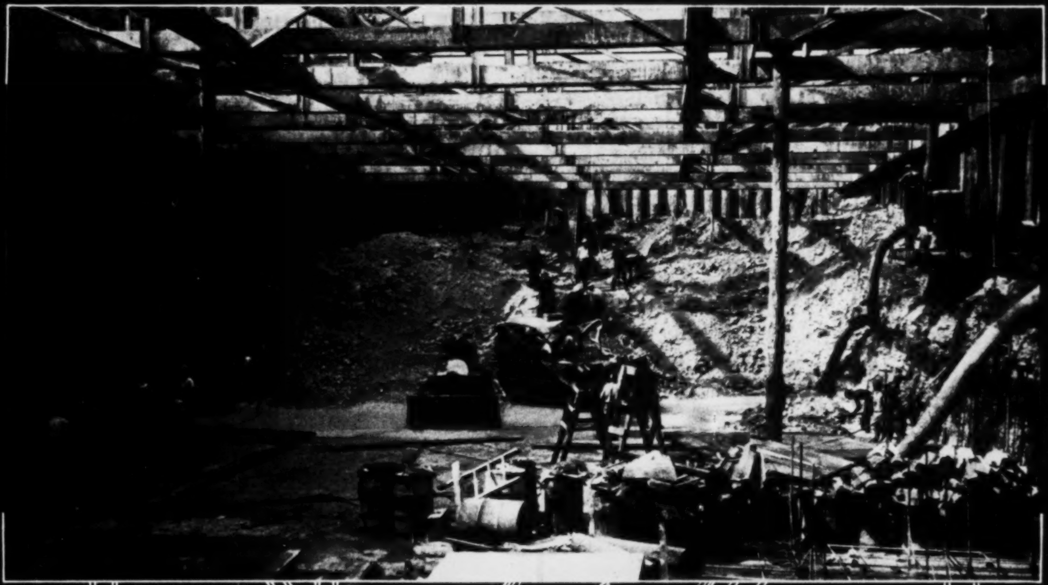
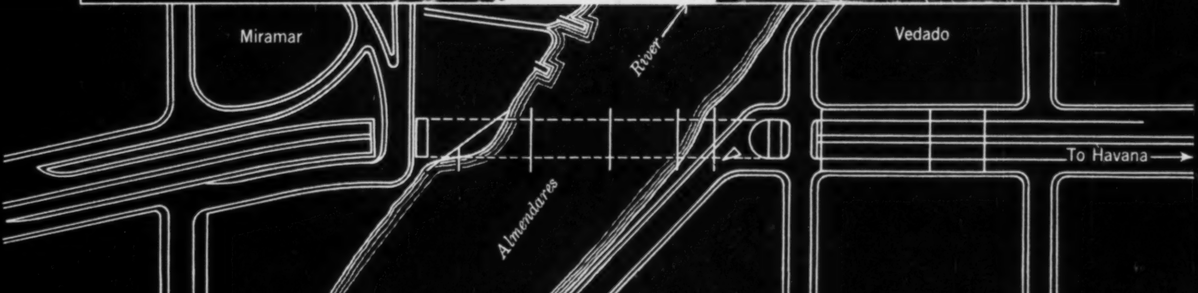
CIVIL ENGINEERING

ALMENDARES RIVER TUNNEL • HAVANA

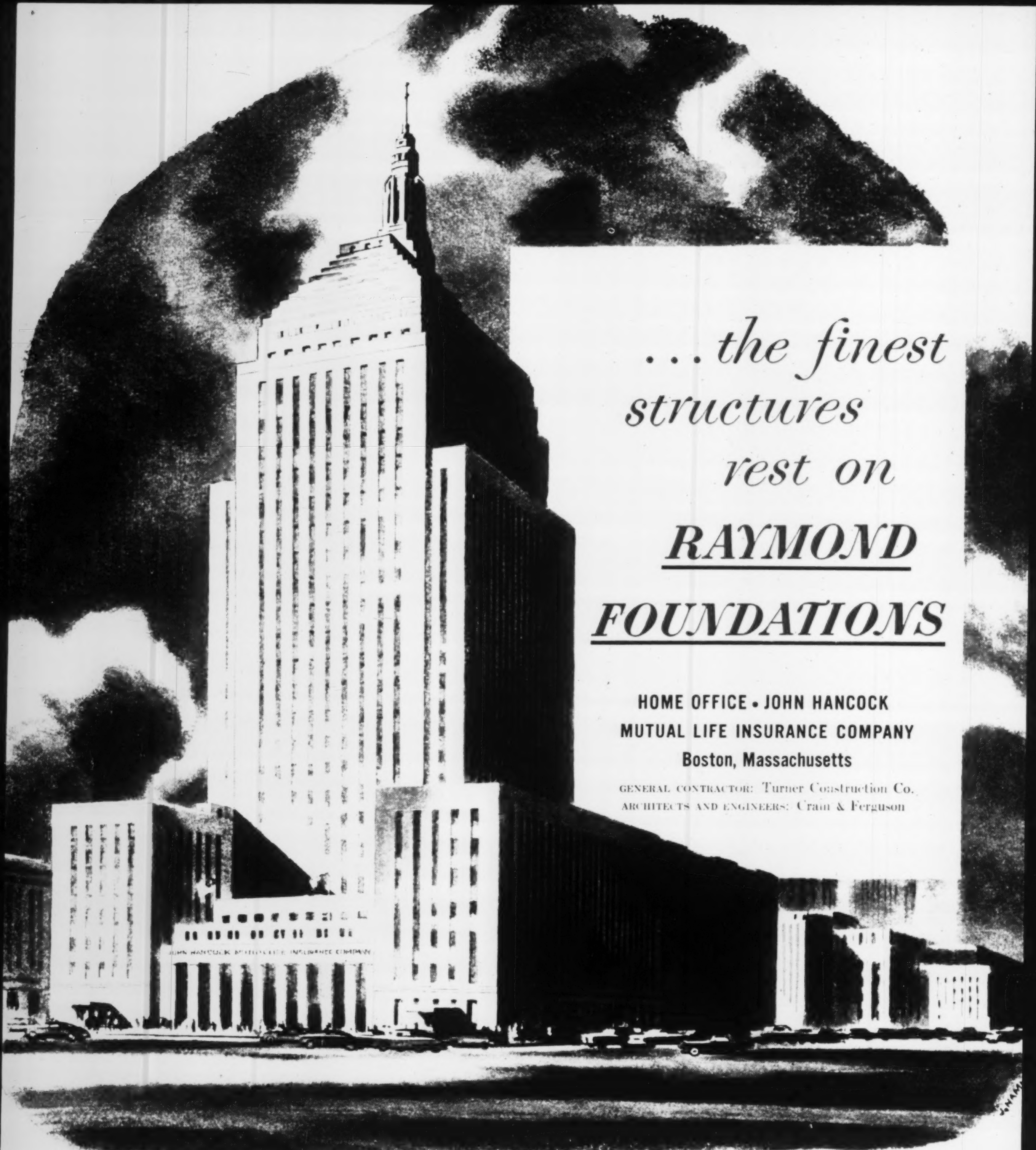

Almendares River




Miramar
Vedado
River
Almendares
To Havana →

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

SEE ARTICLES BY BOSCHEN • PRUGH • KING & ANDERSON


. . . the finest structures rest on RAYMOND FOUNDATIONS
JOHN HANCOCK MUTUAL LIFE INSURANCE COMPANY

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Boston, Massachusetts

GENERAL CONTRACTOR: Turner Construction Co.
ARCHITECTS AND ENGINEERS: Crain & Ferguson

THE SCOPE OF RAYMOND'S ACTIVITIES—Soil Investigations . . . Foundation Construction . . . Harbor and Waterfront Improvements . . . Prestressed Concrete Construction . . . Cement-mortar In-place Lining of Water, Oil and Gas Pipelines.

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CONCRETE PILE CO.
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Branch Offices in the Principal Cities of United States and Central and South America

Tests Prove

CLAY PIPE

can't get

Spongy

Clay Pipe can carry detergents for 500 hours — or 500 years — and it stays as hard and round and smooth as the day it was made.

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When you plan or install sewer lines, guard against "squash-outs." Insist on non-critical, readily available Vitrified Clay Pipe. It's the one pipe you can always count on — for prompt delivery, resistance to chemical action, and dependable performance. *It's guaranteed for 50 years!*

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C-653-6

ESSENTIAL · ECONOMICAL · EVERLASTING

Vitrified

CLAY

CLAY PIPE NEVER WEARS OUT!

PIPE

CIVIL ENGINEERING, The Magazine of Engineered Construction, July, 1953. Vol. 23, No. 7. Published monthly by the American Society of Civil Engineers. Publication office, 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

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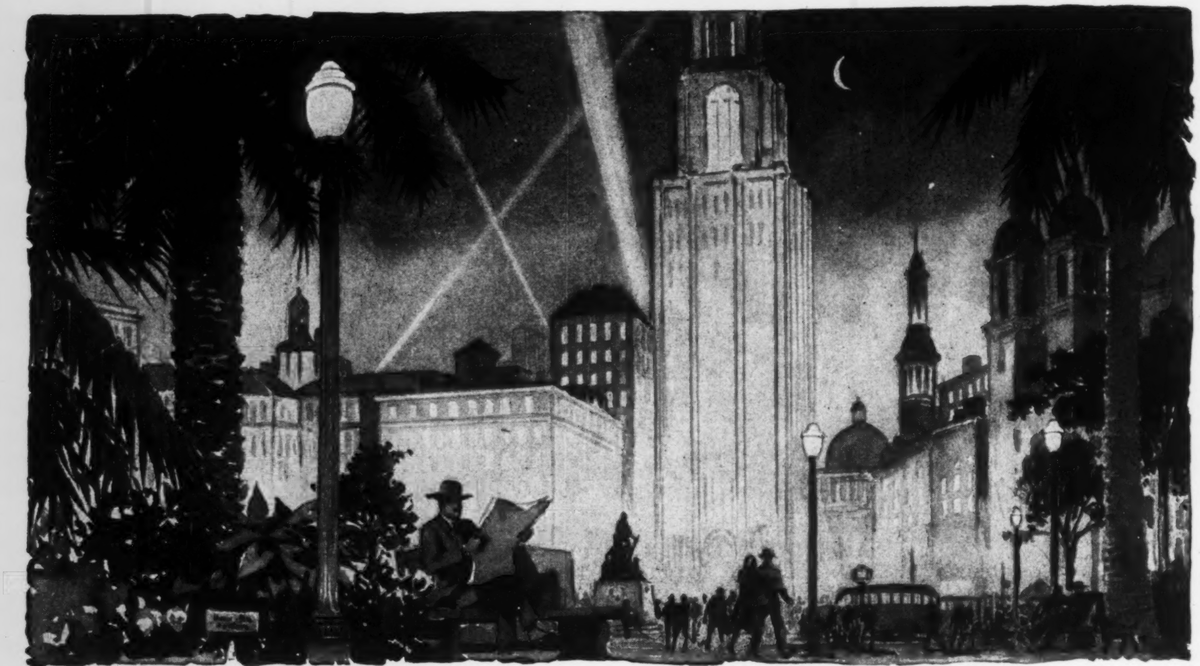

Night-
like the Light of Day

THE SUN drops behind distant hills . . . Darkness enwraps our material existence . . .

But night has little of its pristine terror and tragedy . . .

For witness a wondrous transformation . . .

Electricty dispels the darkness—and the *light of day returns!*

Streets become safer . . . Emergencies in the home and hospital are met . . . Industry functions with nightshifts . . . And storekeepers pursue their trades! . . .

Because of ELECTRICITY generated, often times, hundreds of miles away. Mighty hydraulic turbines tirelessly transform water's energy into useful mechanical energy for the benefit of man!

For more than 77 years, we have pioneered and led in this utilization of water. As a result, we have a wealth of experience and engineering skill *which you can use at a profit by placing your power problem in our **hands!***

If It's Hydraulics-
Put It Up to Us!

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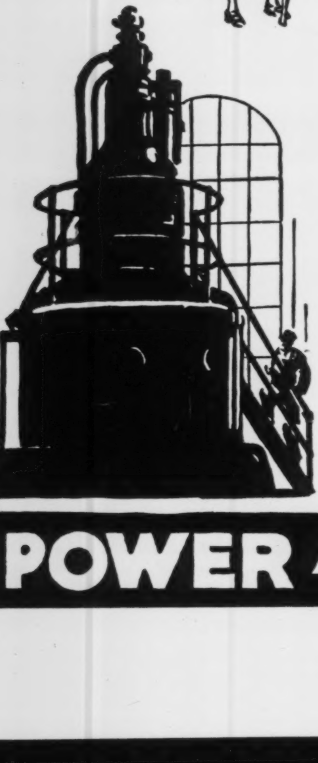
POWER *by* SMITH



NEW!

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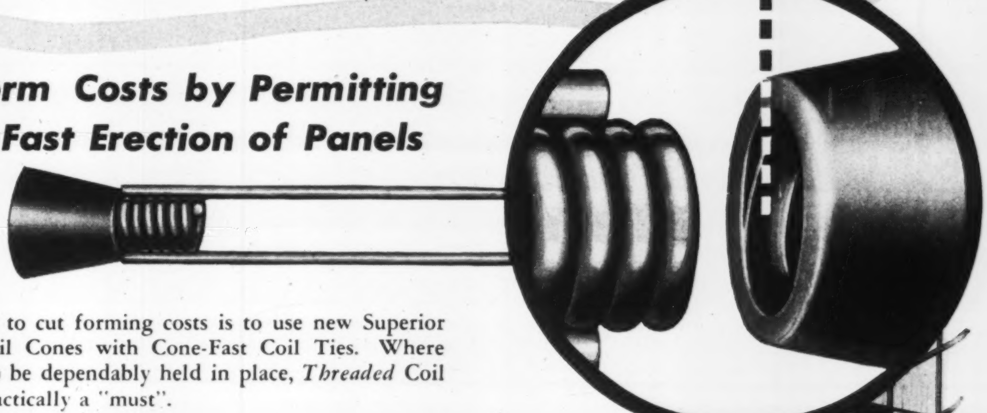
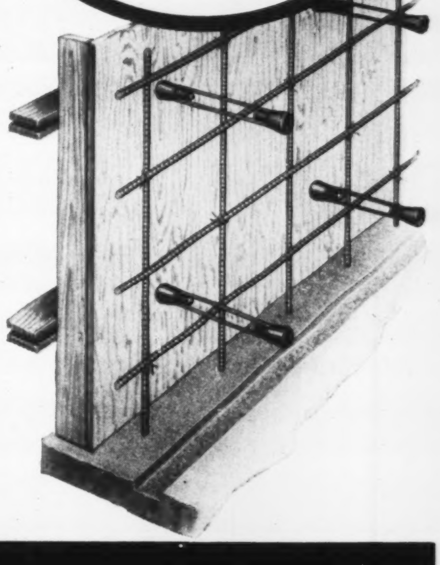
for SUPERIOR

CONE-FAST COIL TIES

Pat No 2.335.338

Cuts Form Costs by Permitting Extra Fast Erection of Panels

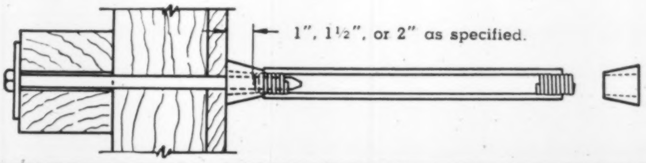




A direct way to cut forming costs is to use new Superior *Threaded* Coil Cones with Cone-Fast Coil Ties. Where cones have to be dependably held in place, *Threaded* Coil Cones are practically a "must".

Previously, Coil Cones were held onto the extended coils by friction alone. Now, a couple of threads in the cone fix Coil Cones securely to the Coil Ties. Here's another advantage . . . units can be bench assembled with the assurance that they will arrive at the installation point intact! *Threaded* Coil Cones cannot be knocked off the Coil Ties when the opposing form is being applied. When unscrewed with a cone wrench, the threaded Coil Cones automatically back themselves out of the wall.

Cone-Fast Coil Ties with threaded Coil Cones are supplied for 1/2" to 1 1/4" Coil Bolts, with safe load capacities from 5,000 lbs. to 36,000 lbs. Working parts (cones and bolts) are returnable for credit.



SUPERIOR CONCRETE ACCESSORIES, INC.
4110 Wrightwood Avenue, Chicago 39, Illinois

New York Office
1775 Broadway, New York 19, N. Y.

Pacific Coast Plant
2100 Williams St., San Leandro, Calif.

CATERPILLAR

Isabella Dam shows the main dam, lower left, and auxiliary dam at right. Granite hill between the two units has outlet tunnel passing through it and spillway over it. Canal feeding from auxiliary dam supplies a power company with water to turn turbines.

2,900,000 cu. yds. of fill moved quickly on Isabella Dam

CAT* equipment and one of the largest rippers ever built team to build a dam to control the Kern River

Isabella Dam, 1,725 feet in length and 185 feet high, is ready to tame the unpredictable Kern River in California. Its completion relieves Bakersfield of the menace of floods and brings promise of greater irrigation to the lower San Joaquin Valley.

The idea was to regulate the Kern, a river of extremes. Its annual flow varies from 1,900,000 acre-feet to as little as 185,000. To do the job Isabella Dam is divided into two sections: the main dam consisting of 2,900,000 cu. yds. of fill; the auxiliary dam, 100 feet high, 3,325 feet long with 1,800,000 cu. yds. of fill. Separating the two is a hill of granite, through which has been holed the 800-foot main outlet tunnel, and over which passes the spillway.

Macco Corporation, Morrison-Knudsen Company Inc., and River Construction Corporation were awarded a $5,873,782 contract for constructing the main dam, completing the auxiliary dam, realigning a section of the canal and building a spillway. They enlisted the aid of a fleet of dependable, swift Caterpillar* machines to do the job which was designed and supervised by the Sacramento District, Corps of Engineers, U. S. Army.

The 2,900,000 yards of fill for the main dam was decomposed granite. Using Cat DW20 Tractors and matching Scrapers, the contractors hauled a daily average of 25,000 cu. yds. over a distance of 4,000 feet in two 9-hour shifts.

The material was broken up by rippers, including one of the largest rippers ever built. Aluminum irrigation pipe was laid across the broken area. The material was sprinkled for several hours, sometimes as much as 48 hours, after which it was picked up by earth-eating DW20 Tractors and Scrapers. Compaction was obtained by a 50-ton Southwest rubber-tired tamper pulled by a

CAT DW20 AND SCRAPER hauls part of the 2,900,000 cu. yds. of fill needed for the main dam. Contractors used a fleet of DW20s on the job, along with D8s, No. 12 Motor Graders and D13000 Engines. With a haul distance of 4,000 feet, the DW20s carried a daily average of 25,000 cu. yds. in two 9-hour shifts per day. Most of the fill was decomposed granite.

DW20. Working in conjunction with the tamper was another DW20 pulling an 18-foot offset disk.

Rugged Caterpillar equipment entered into every phase of the job. In all, the contractors made use of fourteen DW20s with Scrapers, three DW20s with plows and compactors, eight D8s, two No. 12 Motor Graders and D13000 Diesel Engines to power Gardner-Denver compressors.

From experience these contractors know the dollar-saving advantages of standardizing on Caterpillar equipment. Through this wise standardization, their operators and mechanics become familiar with one make of equipment. There is no need to carry a stock of parts. Many parts on Cat Engines are interchangeable—and service from your well-stocked Caterpillar Dealer is prompt.

Why not have your Caterpillar Dealer demonstrate the equipment that will do your job quicker and cheaper? Discover for yourself the reasons why the machines you see on the toughest jobs are always Caterpillar yellow.

THREE CATERPILLAR UNITS work together on the auxiliary dam. Widening and raising the fill are a DW20 pulling a 50-ton tamper, a DW20 pulling an offset disk and a third DW20 spreading fill for the job.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

*Both Cat and Caterpillar are registered trademarks—®

A CAT NO. 12 MOTOR GRADER finishes the bottom of a canal while D13000 Diesels power Gardner-Denver 500 compressors on top of bank. Graders also maintained haul roads.

Announcing . . . the opening of

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Better service for the Western States

"FASTER FROM FOSTER"
NOW EVERYWHERE IN THE U.S.A.
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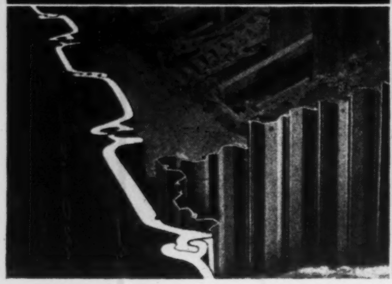
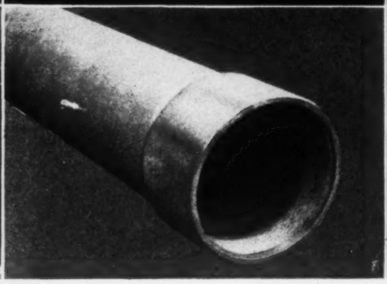
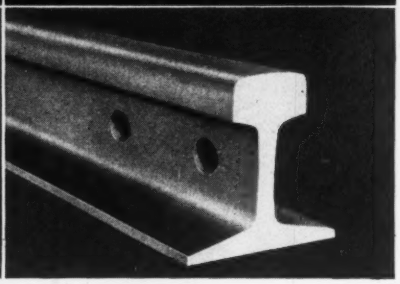
PILING	PIPE	RAILS
		

Bound to be welcome news to ever-growing western industry—L. B. Foster Company opens its Los Angeles headquarters. To users of pipe, rails, and piling who aren't yet Foster customers—we're proud to state that ours is a company that specializes in service—prompt, dependable, backed by the Foster guarantee, and always at the lowest possible prices. Our 50-year list of customers is still growing because buyers seem to "like to do business with Foster." Try us. Let us show you why!

New Telephone
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L. B. FOSTER CO. 3460 WILSHIRE BLVD. • LOS ANGELES 5

PITTSBURGH • CHICAGO • NEW YORK • LOS ANGELES • HOUSTON

ENGINEERING REPORTS:

OPERATING ECONOMY and flexibility are two advantages of using G-E drives at plant's key points. Aggregates are blended in bin, fed into dryer by elevator, then lifted to top of tower by elevator for screening. Dried aggregate is batched and deposited in mixer, where asphalt from tanks at left is also introduced, then mixed and discharged into trucks.

Asphalt plant electrified for portability, high output

G-E drives simplify operation of 125-ton-an-hour Heldenfels Bros. plant; no repairs needed in two years

This portable motorized asphalt plant—owned and operated by Heldenfels Bros. Co. of Corpus Christi, Texas, and built by Iowa Manufacturing Co., Cedar Rapids, Iowa—is largest in the area. Key to its 125-ton hourly output—approximately twice as much as non-motorized plants—is simplified operation and portability, made possible by co-ordinated General Electric motors and control. Plant is easily broken down for relocation. And, says Mr. F. W. Heldenfels, "not one cent has been spent for electrical repairs in over two years of continuous operation."

The plant's G-E drives provide operating reliability, plus one-man control. The gear-motors, small and light considering their power, take up minimum space, and are remounted quickly. Over-all plant weight is reduced, flexibility added.

For faster, easier, more efficient operation of *your* construction equipment, electrify with G-E drives and power distribution equipment—backed by G-E engineering help in application, installation and service. General Electric, Schenectady 5, N.Y.

664-29

1878 75 1953
YEARS OF ELECTRICAL PROGRESS

EASY TO RE-LOCATE G-E motors and control, like this 50-hp totally enclosed gear-motor, can be quickly transported by truck from one job to the next.

ONE-MAN CONTROL of plant's production is possible with G-E remote control panel in tower, from which dryer, elevators and conveyors are operated.

Engineered Electrical Systems for Heavy Construction

GENERAL ELECTRIC

MIXING BLACKTOP

FINISHING SLOPES AND SHOULDERS

MOVING WINDROWS

GRADING SLOPES

CLEANING DITCHES

you've got to
Swing that Rear-End
for TOP performance

Austin-Western Power Graders do a superlative job on blacktop. ALL-WHEEL DRIVE provides the power and traction for high-speed operation. PRECISION SIDE SHIFT moves the blade in or out, as desired, while the grader is in motion. Ample throat room between top of blade and bottom of circle makes it possible to move a tremendous windrow without interference.

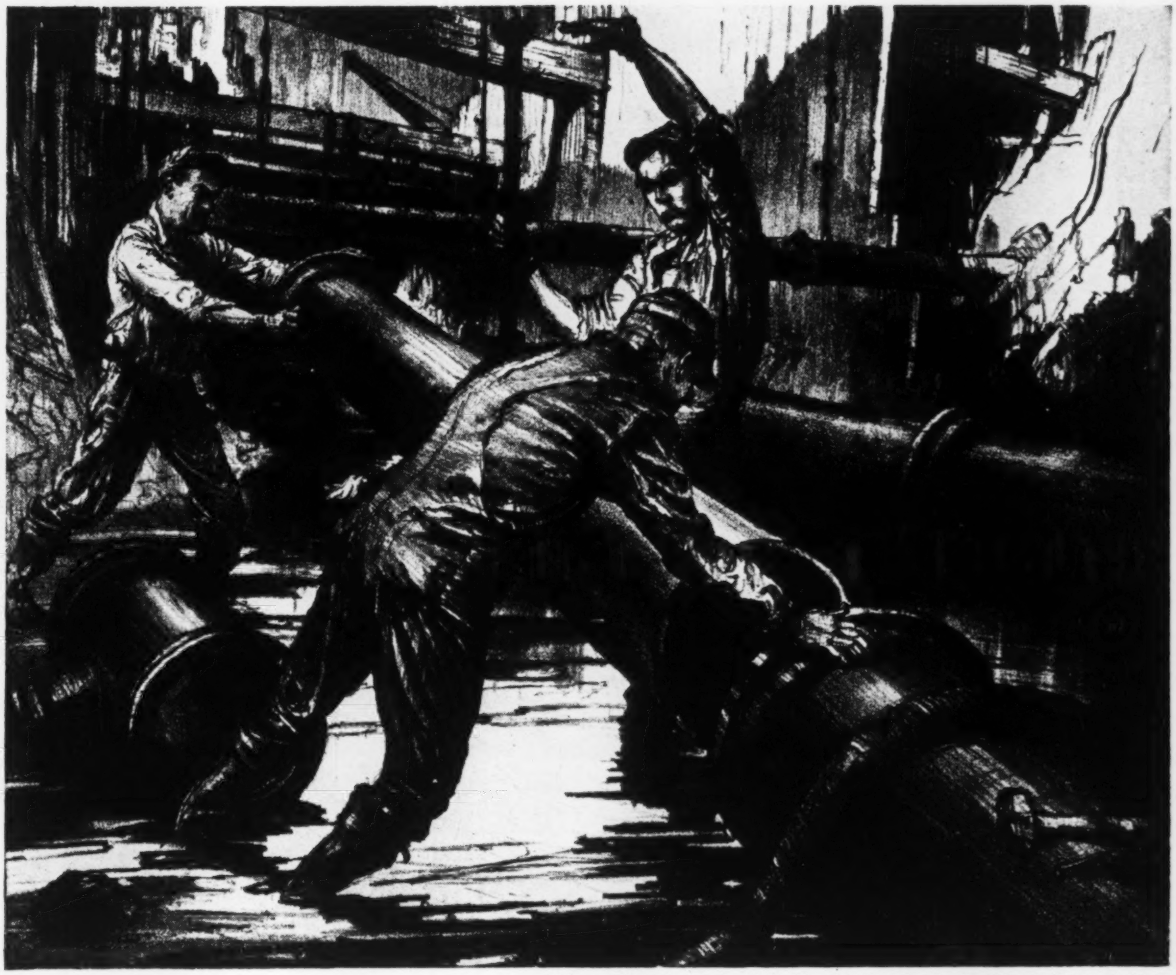
CONTROLLED TRACTION — product of exclusive ALL-WHEEL DRIVE and ALL-WHEEL STEER — places all wheels where they miss the windrow; moves a maximum amount of material the maximum distance. Yes, on oil mix, as on many other types of work, you've got to SWING THAT REAR-END for *top* performance.

...handling many other jobs

Austin-Western
Power Graders
Road Rollers · Motor Sweepers

BALDWIN BLH LIMA-HAMILTON
Construction Equipment Division

Manufactured by
AUSTIN-WESTERN COMPANY
Subsidiary of Baldwin-Lima-Hamilton Corporation
AURORA, ILLINOIS, U.S.A.



Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

CAST IRON PIPE is a versatile pipe. It has age-old and outstanding service records in water, gas and sewerage fields.

Today's U. S. cast iron pipe centrifugally cast in metal molds combines the long life characteristics of the older type of pipe with all the advantages gained through the use of a modern manufacturing process and rigid quality controls.

Whether your requirements call for centrifugally cast iron pipe in sizes 2- to 24-inch, pit cast pipe in the larger sizes or fittings—all with various types of joints and in accordance with standard specifications—we are in an excellent position to meet them promptly from our five strategically located plants.

United States Pipe and Foundry Co.,
General Office, 3300 First Ave., N. • Birmingham 2, Ala.
Plants and Sales Offices Throughout the U. S. A.

U.S.
CAST IRON
PIPE
[illegible] AND INDUSTRIAL SERVICE

☞ Our General Office will be moved about July 15th from Burlington, N. J. to Birmingham, Ala.

is less likely to happen on CONCRETE

A Georgia State Highway Department report, "Traffic Accidents—Highway Conditions," offers evidence of the safety of concrete pavement.

From this report a year's accidents on nine federal routes with 677.44 miles of concrete and 1437.74 miles of the other most commonly built pavement were analyzed. Traffic volume on the two types was about equal.

Accidents due to human frailty or mechanical failure were omitted. That left 257 accidents involving eight deaths, 177 injuries and $139,672 of property damage. *For equal traffic there were 2.38 times as many accidents, 3.25 times as many deaths, 4.11 times as many injuries and 4.02 times as much property damage on the other pavement as on concrete.*

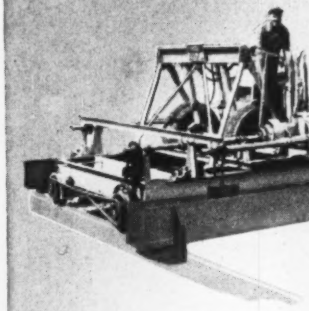
Highway safety means good engineering. It also means concrete paving. You can see better on it at night and it's skid resistant, wet or dry.

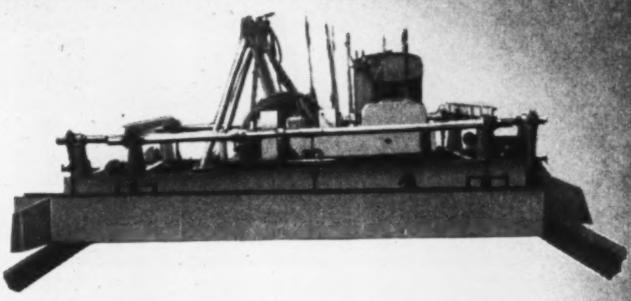
the SAFE pavement is concrete

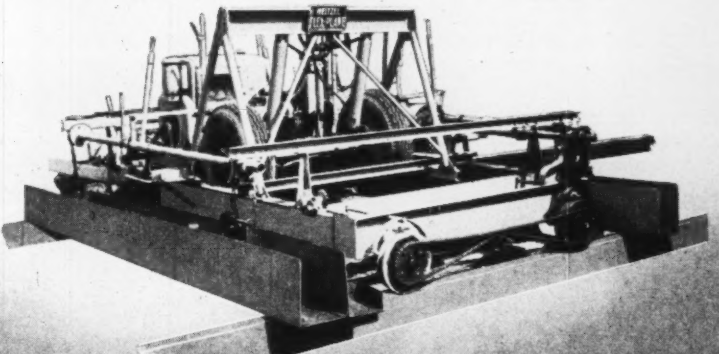
PORTLAND CEMENT ASSOCIATION

33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work







YOU'RE LOOKING AT THE MOST MOBILE CONCRETE FINISHER IN THE WORLD . . . .

Here are three views of one of the most heralded machines in highway and airport construction history. It's the super portable Flex-Plane Detroit Special Finishing Machine.

Wherever one of these machines is in operation you'll discover the contractor using the machine has been able to work faster at less cost.*

Completely portable, the machine will lift itself from the forms and convert itself into a "trailer" in a minute . . . ready to be taken to the next job with a minimum of make-ready and idle crew time.

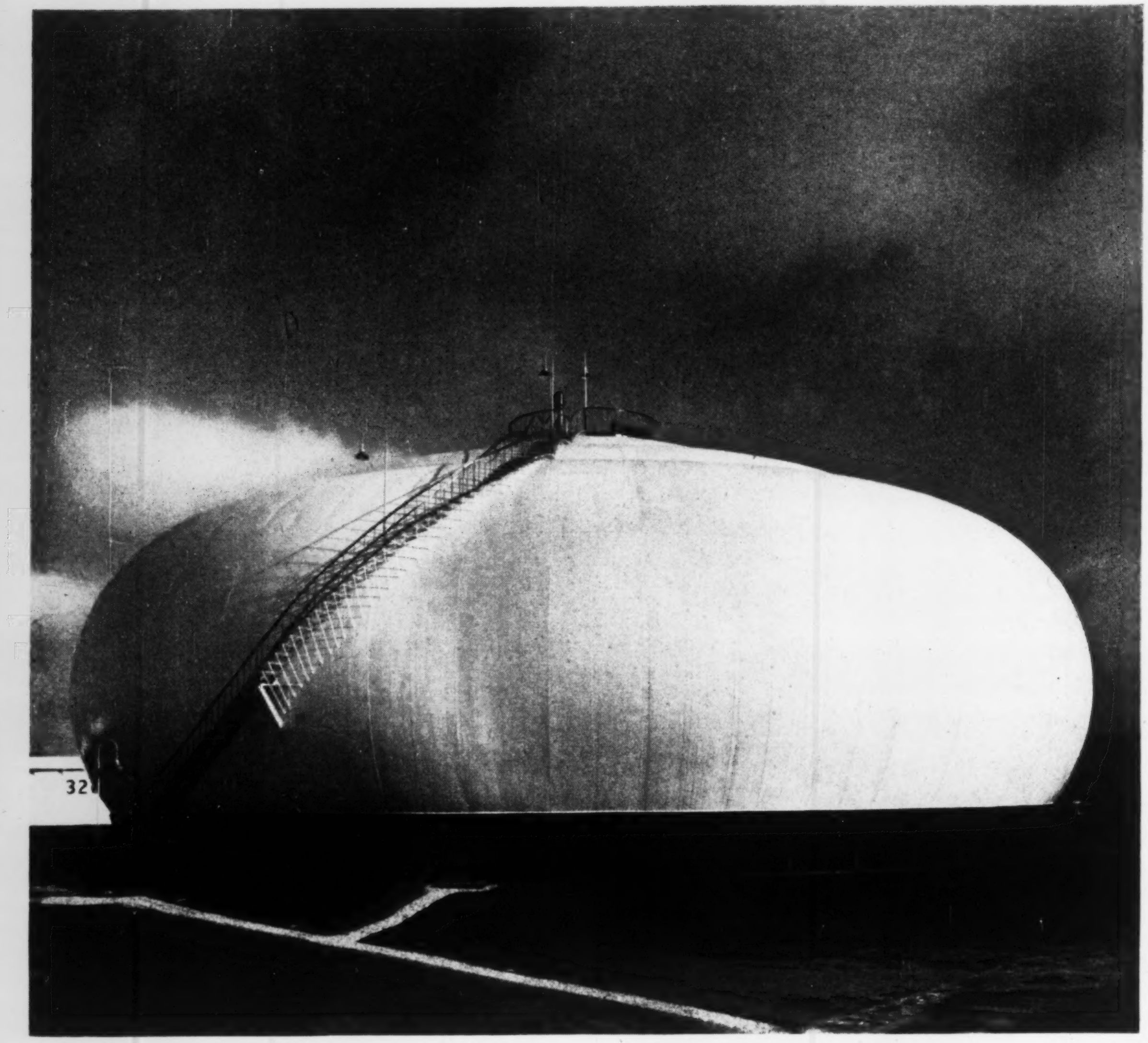
THE SUPER PORTABLE FLEX-PLANE DETROIT SPECIAL

Special screeds and screed mounts enable this speedy machine to finish any type surface in the manner specifications call for. Both screeds are mounted outside the frame which permits faster screed changes. Machine is telescopic . . . can be altered to fit any size job in approximately 15 minutes. If you are in the business of building concrete streets, highways or landing strips, you can't afford to overlook this cost-cutting finisher. To get all the facts drop a note on your company letterhead to the **Flexible Road Joint Machine Company, Warren, Ohio,** today.

** Ask for name of contractor nearest you operating a Detroit Special—talk to him about the quality of work, the speed and the savings he has been able to get by using this great machine.*

THE HELTZEL STEEL FORM AND IRON CO. Heltzel WARREN, OHIO

THE FLEXIBLE ROAD JOINT MACHINE COMPANY Flex-Plane WARREN, OHIO



Union Oil Installs 80,000-barrel Hortonspheroid

Union Oil Company of California recently installed the Hortonspheroid illustrated above at its Los Angeles refinery in Wilmington, California. The structure has a capacity of 80,000 bbls., is $127\frac{1}{2}$ ft. in diam., 40 ft. to the high liquid level and is designed for a working pressure of 8 lbs. per sq. in.

This large, noded Hortonspheroid was installed to store stabilized natural gasoline for blending purposes. Approximately 5,000 bbls. are used from it each day.

Union Oil's own absorption-type plants in the Los Angeles basin area supply most of its natural gasoline requirements. The balance is obtained from other producers and shipped to the refinery by pipe line, tank truck or tanker.

Noded Hortonspheroids are built in standard capacities from 20,000 to 120,000 bbls. Plain Hortonspheroids are built in standard capacities from 2,000 to 40,000 bbls.

In addition to Hortonspheroids, we build a complete line of steel plate structures. They include Horton Floating Roofs, Hortonspheres, Hemispheroids, Vaporspheres, Vaportanks, Hortondome Roofs, flat-bottom tanks, digesters, refinery towers and elevated steel tanks. For further information, estimates or quotations on any of these structures, write our nearest office. There is no obligation on your part.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3..............2167 Healey Bldg.
Birmingham 1..........1596 N. Fiftieth St.
Boston 10........1009—201 Devonshire St.
Chicago 4..........2199 McCormick Bldg.
Cleveland 15..........2263 Guildhall Bldg.
Detroit 26............1541 Lafayette Bldg.
Havana....................402 Abreu Bldg.
Houston 2...........2128 C & I Life Bldg.
Los Angeles 17....1556 Gen. Petroleum Bldg.
New York 6.....3395—165 Broadway Bldg.
Philadelphia 3..1652—1790 Walnut St. Bldg.
Pittsburgh 19.............3210 Alcoa Bldg.
San Francisco 4........1584—200 Bush St.
Seattle 1..................1309 Henry Bldg.
Tulsa 3.....................1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

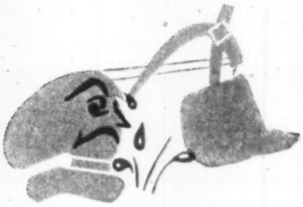
there are
TWO WAYS
to build a line
of excavators
BOWLING

1/THE EASY WAY . . .

. . . is to design a few basic machines, and then build up a line of additional models by adding extra counterweight, speeding up the engine, and hanging different size dippers on each.

Z-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z

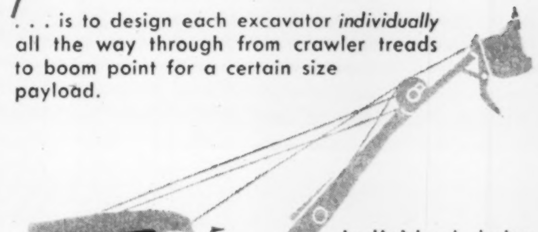
Some of these machines will carry dippers too small. Output will be reduced, power wasted.



Other machines with dippers too large and counterweight too heavy will sweat and strain from overwork.

2/THE BUCYRUS-ERIE WAY

. . . is to design each excavator *individually* all the way through from crawler treads to boom point for a certain size payload.



Individual design means bigger loads on every bite, faster digging cycles, lower maintenance costs, longer machine life. All these add up to higher overall output, lower overall, costs. Compare *individually designed* Bucyrus-Eries with excavators in any other line before you buy. Ask your Bucyrus-Erie distributor to give you complete details on how individual design means bigger output for you.

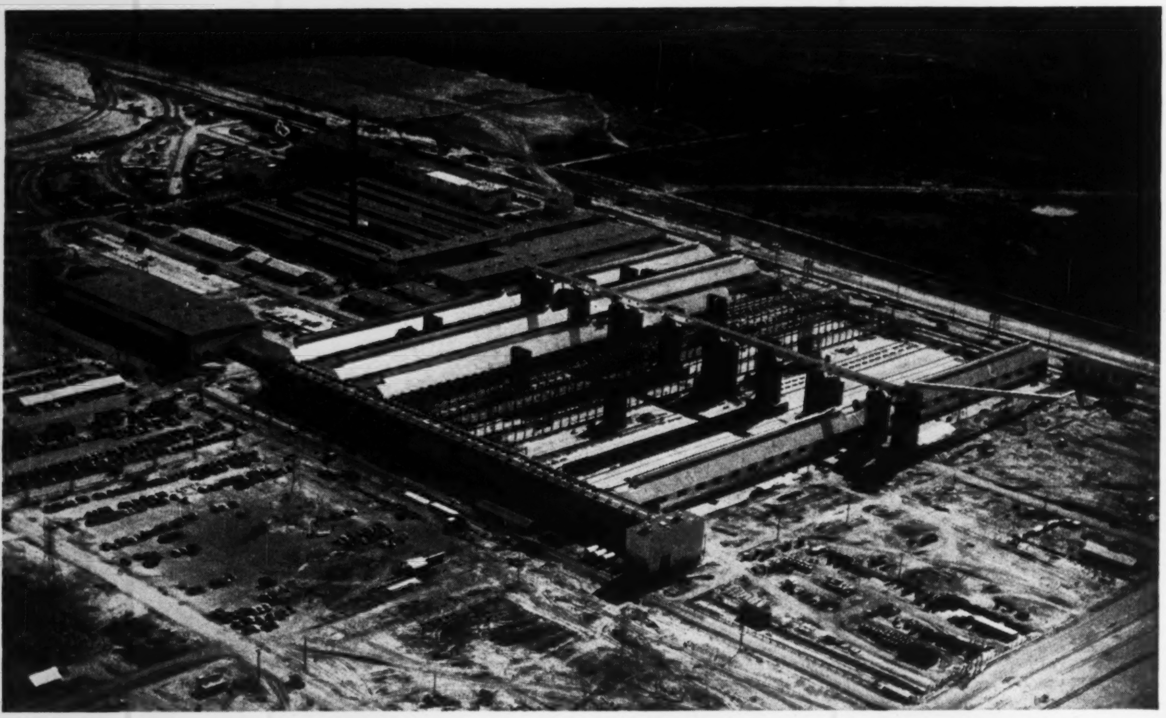
9E53C

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

3/8- to 4-yd. Gasoline, Diesel,
Single Motor Electric Excavators

HYDROCRANE • HYDROHOE



Aerial view of 90-acre Rockdale Works of Aluminum Company of America. Steelwork fabricated and erected by Bethlehem.

New Giant in the Southwest

This huge smelting plant at Rockdale, Texas, northwest of Houston, is the new Rockdale Works of Aluminum Company of America. It reduces refined bauxite to aluminum by means of an electrolytic process. It is the country's first aluminum plant to use lignite as a source of power.

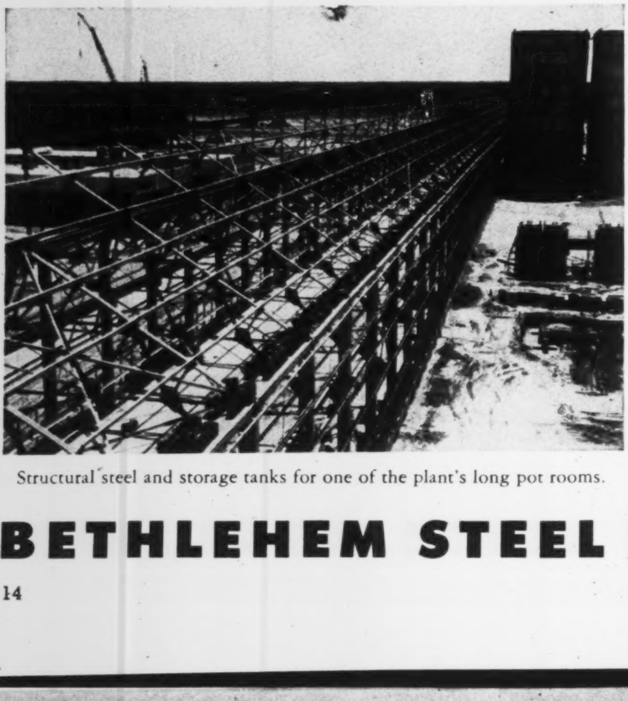
The Rockdale Works is now in operation, but is not scheduled for completion until the fall of 1953. It will include a smelting plant with four pot lines and a plant for the manufacture of the carbon electrodes required in the electrolytic smelting process. Annual capacity of the new plant is expected to be approximately 170,000,000 lb.

The Rockdale Works covers 90 acres. It consists of 25 large industrial-type buildings, for which Bethlehem fabricated and erected 11,000 tons of structural steel.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM
STEEL



Structural steel and storage tanks for one of the plant's long pot rooms.

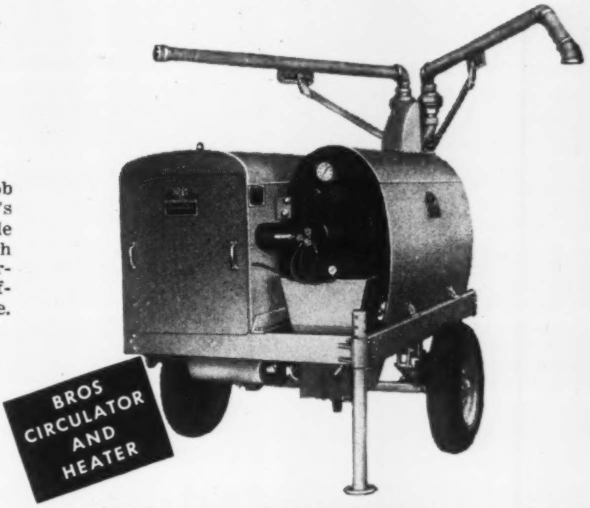
BETHLEHEM STEEL CONSTRUCTION

Handling Bitumens? Want to Cut Costs?

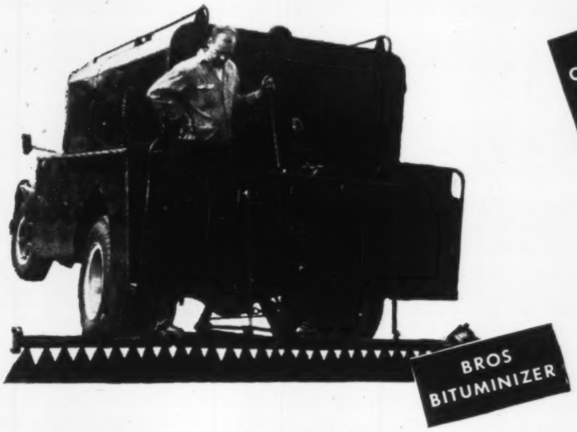
One of the best answers to high operating costs these days is *better equipment* . . . equipment that works fast . . . with highest possible efficiency . . . and that stands up day after day under all kinds of operating conditions. For the handling of bitumens, these *Bros* units are terrific. They've got new, exclusive design features . . . they're simple . . . and they're built with extra muscle and strength for long life. They'll pay their way on your next job!

BROS PORTABLE STEAM GENERATOR

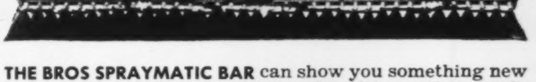
FOR HEATING asphaltic materials faster, and for any job where steam is needed, you can't beat this *Bros* steamer. It's portable, compact, weatherproof. It has the best possible boiler design for an uninterrupted supply of steam at high ratings. Its working controls are so simple anyone can operate it. Requires only routine blow-downs because it is self-cleaning. No water treatment necessary. Three sizes available. Make steam the best way—the *Bros* way!



FOR PUMPING and HEATING bitumens in spots where steam is not needed, this *Bros* unit will earn your praise in short order. It has an exclusive 2-way heating feature for faster and more even heating. A low center of gravity makes roadability a big feature—take it anywhere! Has 4 distinct pumping speeds with widest heat transfer range. Material can be left in unit and re-heated to help start cold tank cars. It's the champ of its class!



FOR SPREADING with greatest control at lowest cost, here's your answer! Take a look—the gingerbread is gone. No complicated gadgets or congested piping—this new streamlined *Bros* unit sets a new standard of distributor design. Its amazing heating action comes from a tremendous heating surface area. Operators say the working end is so easy to operate that they can spread better and faster than ever before!



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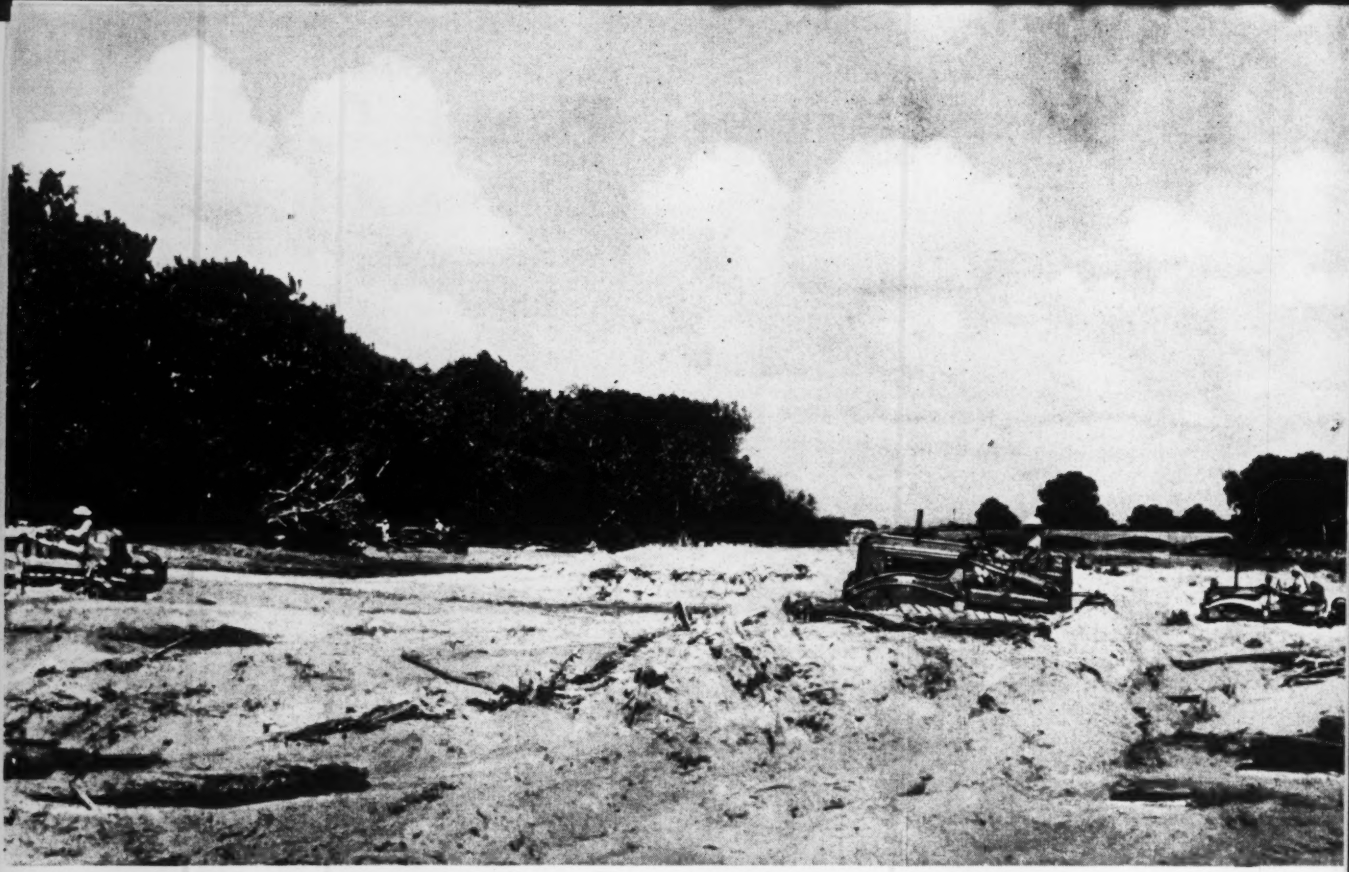
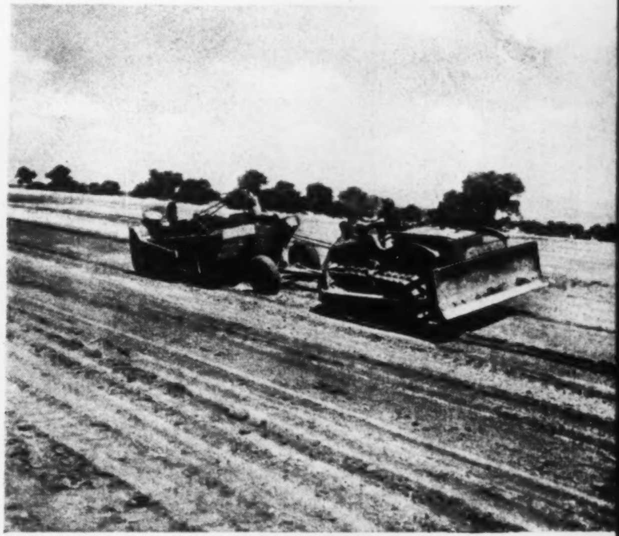


REMAKING A RIVER BED. The channel of the Arkansas River is being realigned by this fleet of International crawlers owned by the C. W. Kelley Transport Company, Inc., and Rush Construction Company, shown cutting new channel through section of island.

Speeds up Sleepy River

RIVER CROSSING. International crawlers reach islands to start rechanneling work by building earth ramps across the river. They worked in sand and water throughout the summer with no downtime.



CHANGING THE CHANNEL. Operator Kie Bayless says: "These TD-14As have more 'soup' than any other tractor their size. They just plain move more dirt."

International crawlers speed up flow of Arkansas River as safeguard for Kansas wheat belt

Flow of the long and lazy Arkansas River is being speeded up one-third along a 30-mile stretch in Reno County as a flood prevention measure aimed at safeguarding the rich wheat belt in this Kansas County.

When the river rises just six feet, and it does periodically, it spills all over the wheat fields and causes extensive damage.

But county officials feel they have a solution. This year they launched the first portion of a proposed three-year plan involving some $50,000 expenditure each year for elimination of bad turns and islands in the river channel. This improvement will increase the flow of the river from 4.06 feet per second to 5.41 feet per second or more and it is felt this faster flow will be sufficient to keep the river in its channel.

Dirt moving for the first-year phase of the improvement is being handled by Rush Construction Company and C. W. Kelley Transport Company, Inc., with rugged red International TD-18A and TD-14A crawlers.

H. M. Dunsworth, job foreman, reports:

"We lug these TD-18As and TD-14As down all the time. They not only have the power and maneuverability to do a bang-up dirt moving job, but that high-speed reverse sure makes us money on this river job as lots of the dozing calls for long pushes. These Internationals, and some have been used for years, have worked over two months here under miserable conditions with absolutely no downtime."

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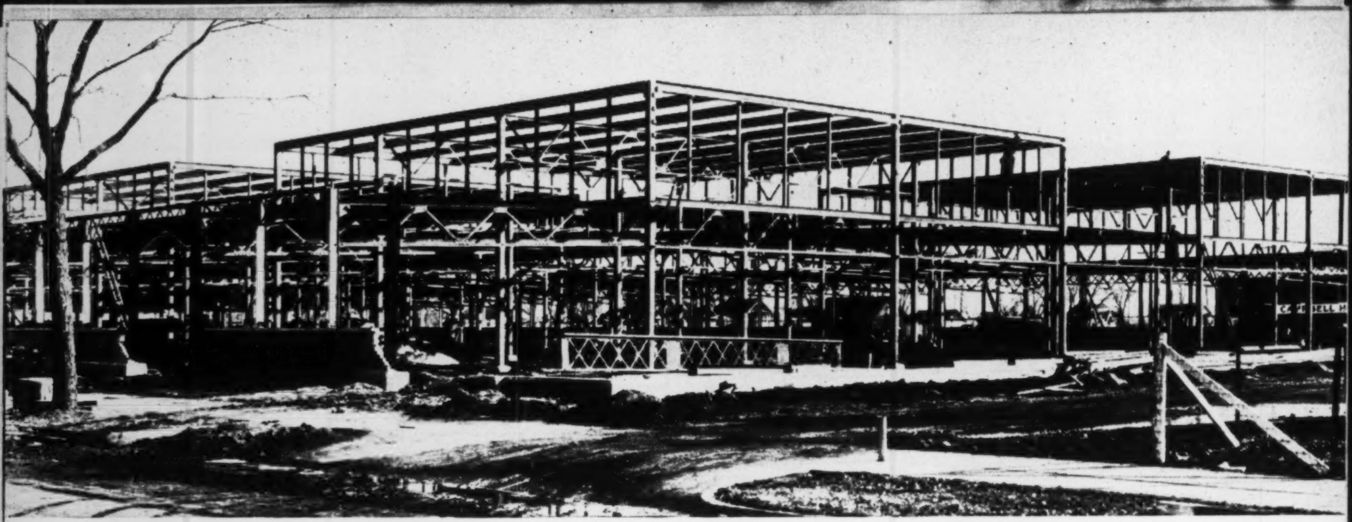

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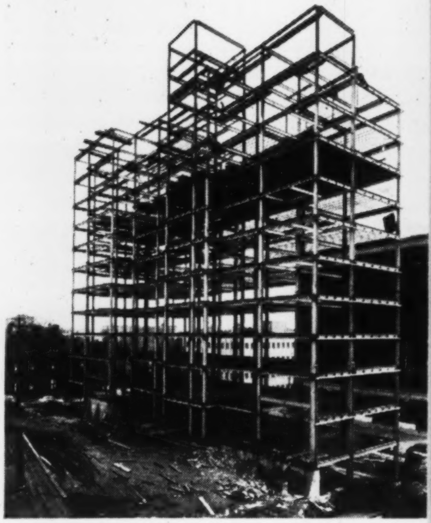

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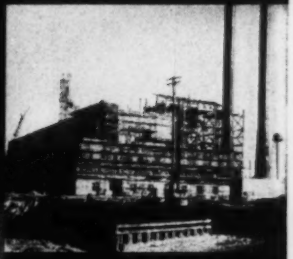
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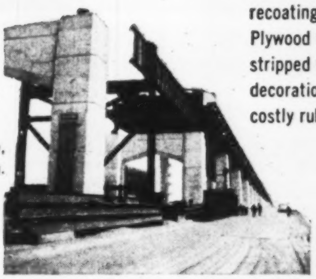
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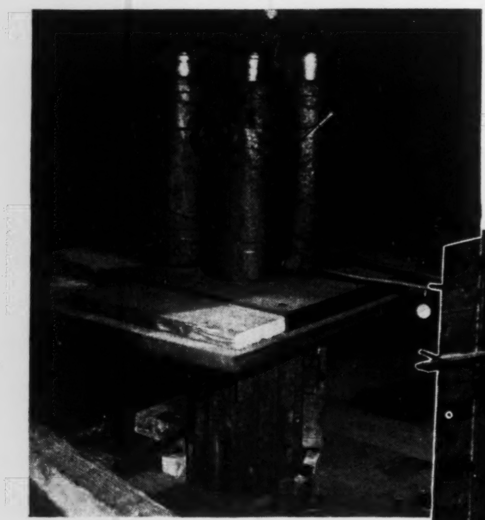
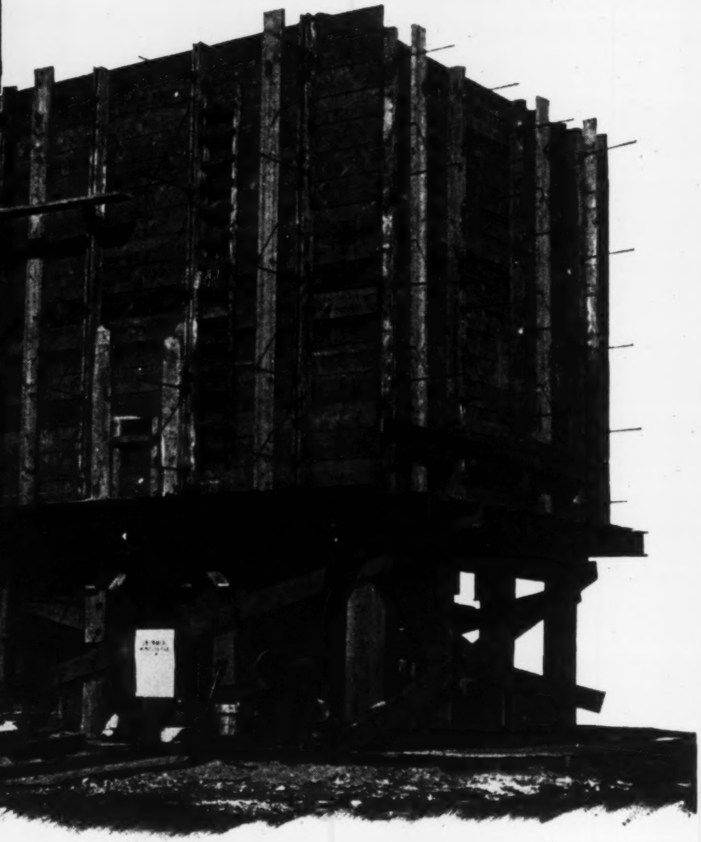
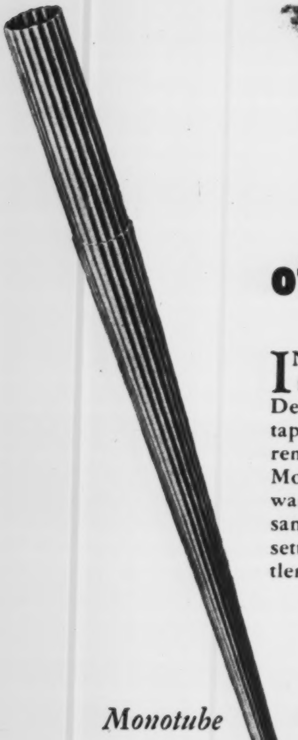




4 hydraulic jacks bearing against a huge sand-filled crib, used in applying 250-ton load to a single Monotube pile. This testing work was done for Delaware River Port Authority by consulting engineers Modjeski & Masters—Ammann & Whitney, with pile driving and loading by Brann & Stuart Co., Philadelphia, Pa.



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A TYPE THAT WILL DO YOUR JOB BEST

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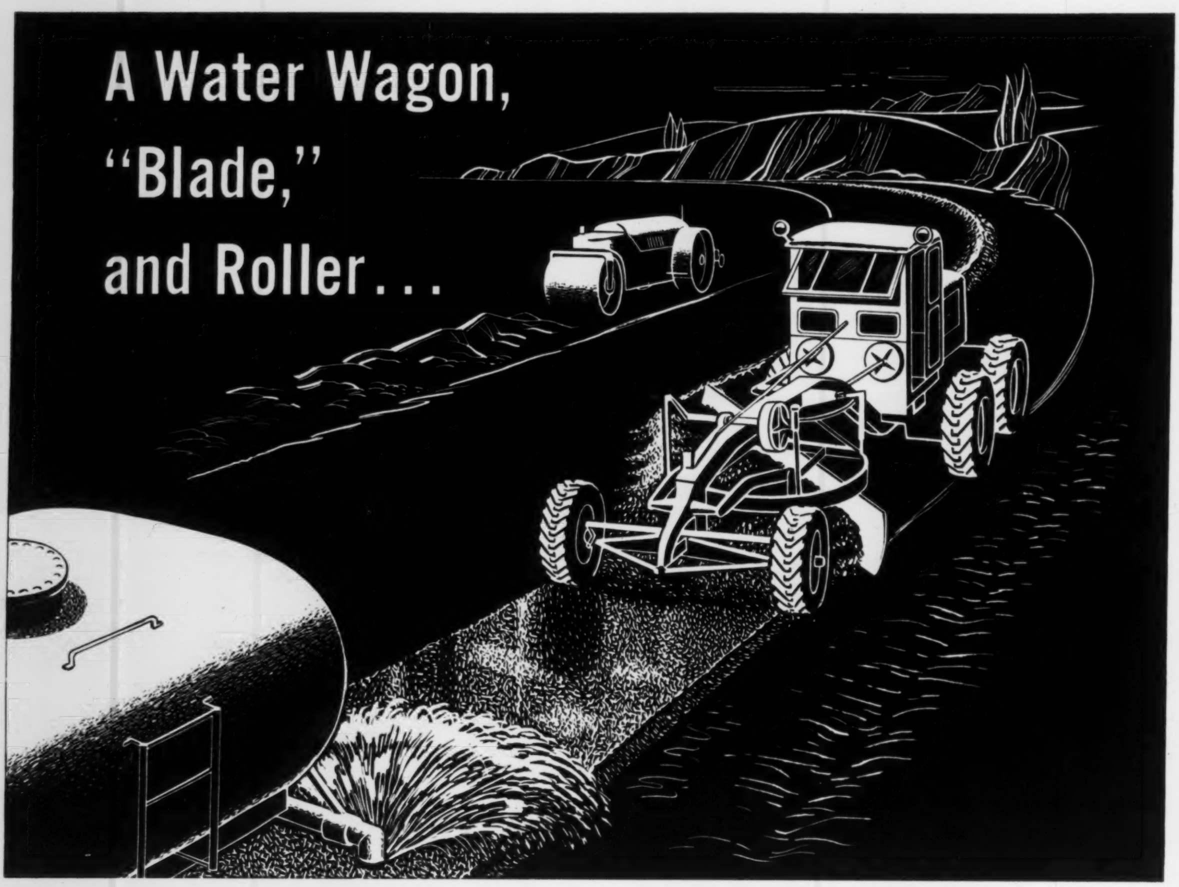

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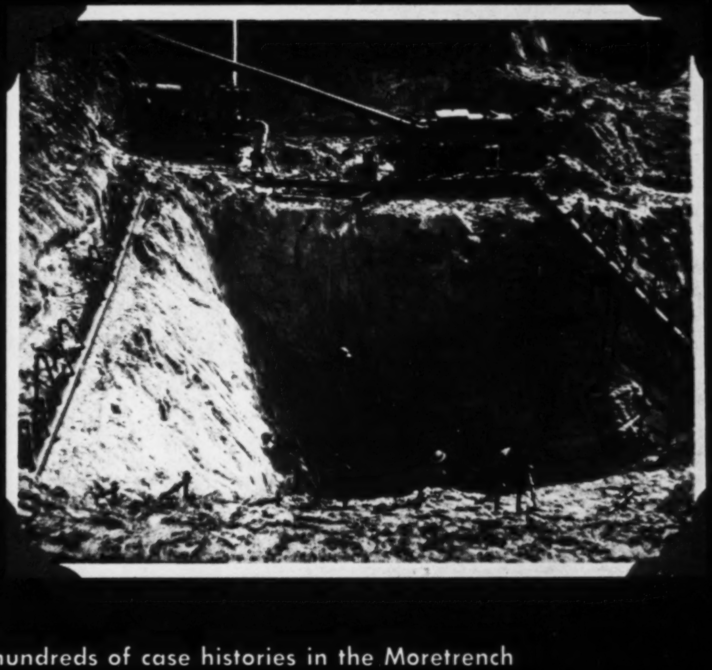

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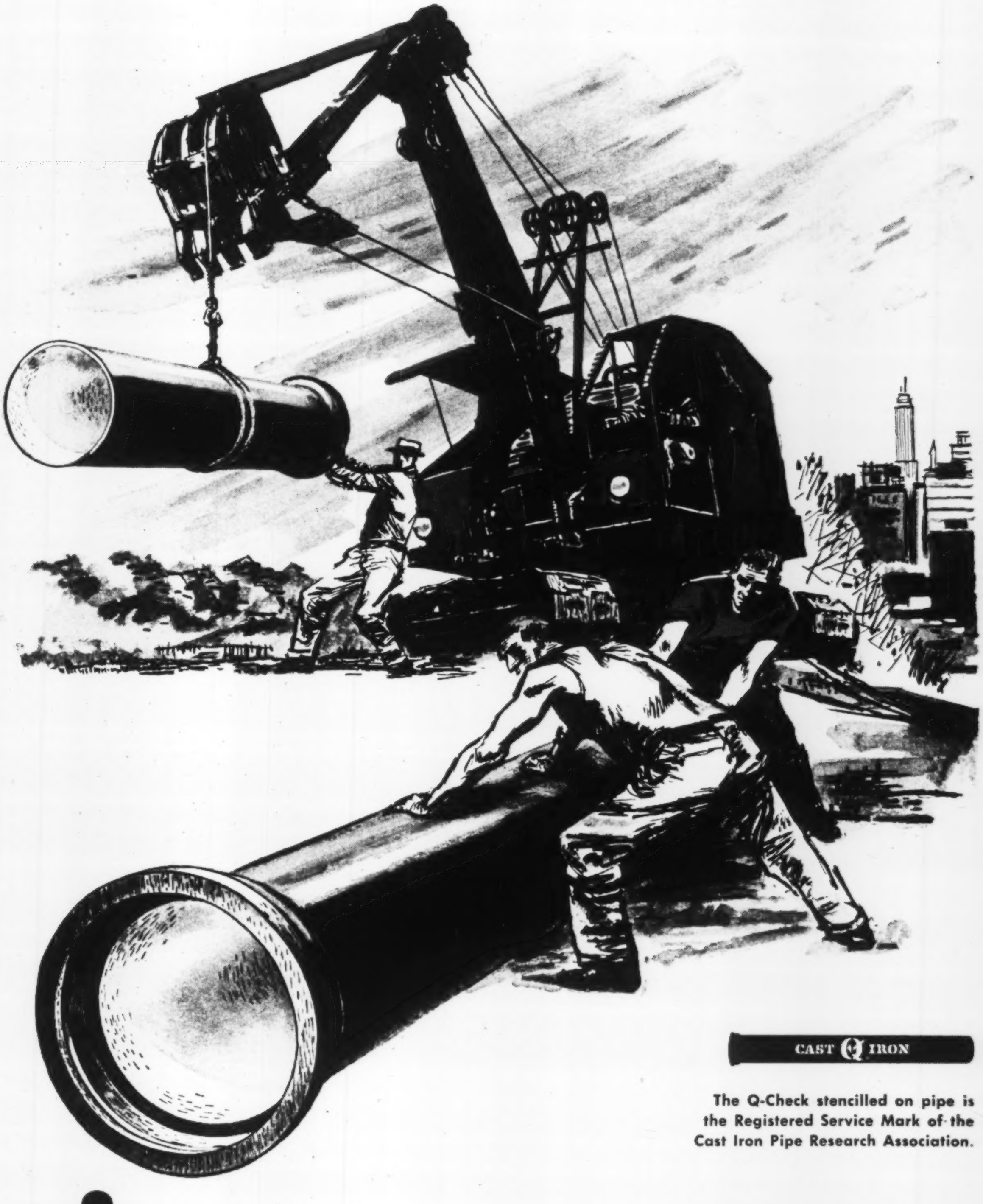
This cast iron water main, uncovered for inspection, is in good condition after over a century of service in Detroit, Mich. —one of more than 45 cities with century-old water or gas mains in service.

Modernized cast iron



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*Reg. U. S. Pat. Off.

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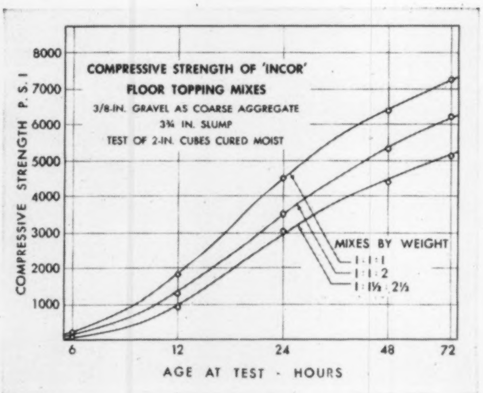

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CIVIL ENGINEERING

JULY 1953

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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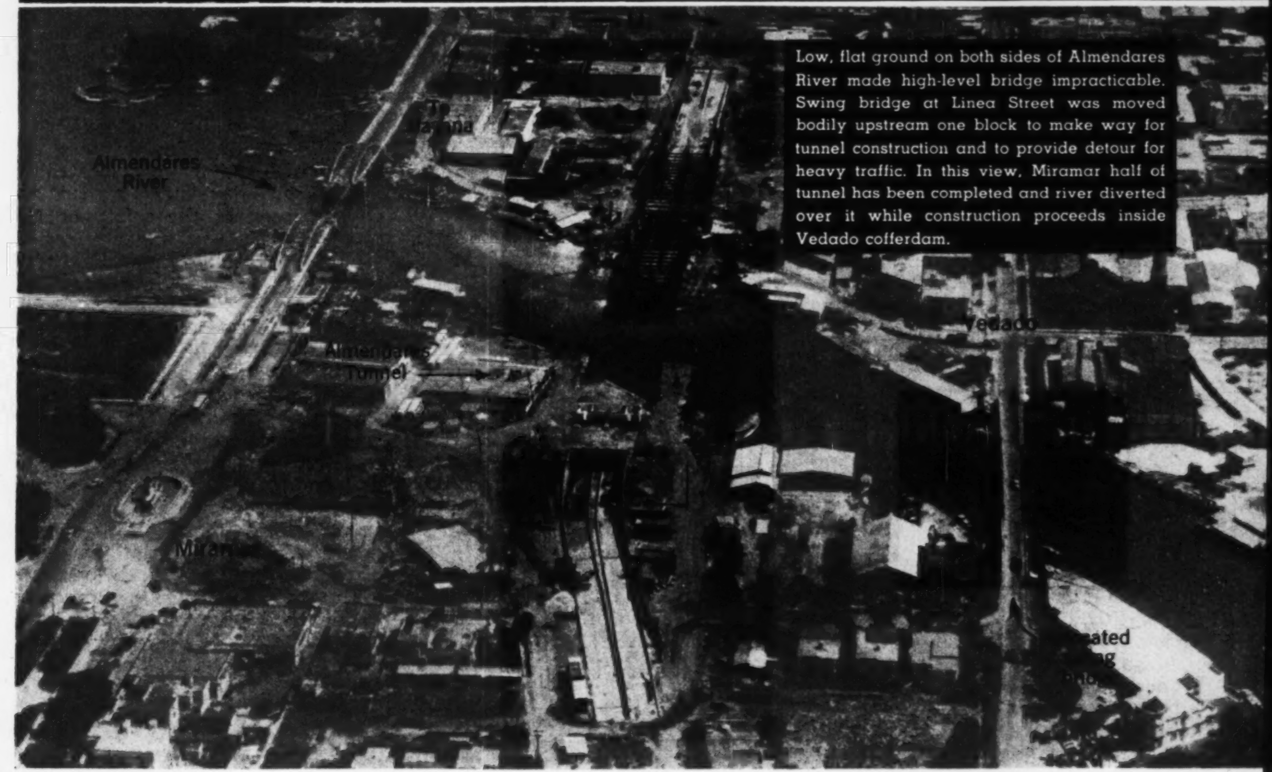


Low, flat ground on both sides of Almendares River made high-level bridge impracticable. Swing bridge at Linea Street was moved bodily upstream one block to make way for tunnel construction and to provide detour for heavy traffic. In this view, Miramar half of tunnel has been completed and river diverted over it while construction proceeds inside Vedado cofferdam.

Havana traffic tunnel built in the dry under Almendares River

H. C. BOSCHEN, M. ASCE, Vice President, Raymond Concrete Pile Co., New York, N.Y.

The Almendares Tunnel project (Fig. 1) grew out of the demand for better vehicular communication between Vedado and Miramar, two of the most popular residential areas of Havana, Cuba. These two communities are separated by the Almendares River, which in 1951 was spanned by three bridges. One of these, a high-level bridge, was situated some distance back from the sea coast and did little to relieve the heavy traffic between North Miramar and Vedado and Havana. The other two bridges, on the lower reaches of the river, had movable spans to permit the passage of river traffic.

Businessmen going to and from their homes and offices crossed the river in a steady stream, morning, noon and night, while heavy river traffic, both commercial and pleasure, demanded continual opening of the bridges. The consequent traffic congestion became steadily worse until in 1951 the national government of Cuba, through its Comision de Fomento Nacional, took steps to relieve the situation.

The land on both sides of the river, being flat and low, precluded a high-level crossing without long and unsightly approaches. Such a structure

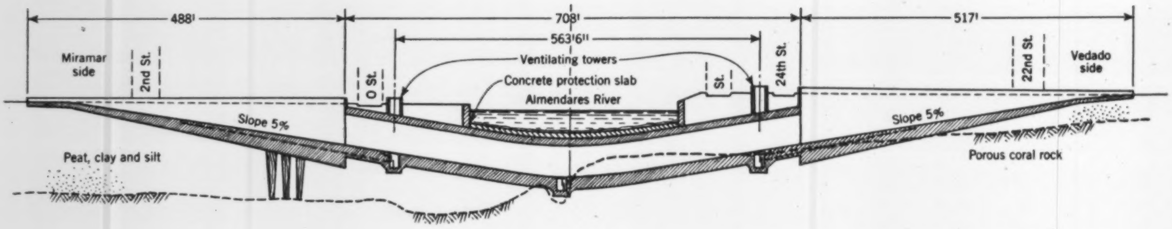


FIG. 1. Almendares Tunnel relieves traffic congestion between residential and downtown areas of Havana, Cuba. On Vedado side of river, porous coral rock, sealed by grouting, supports concrete tunnel slab; on Miramar side, where rock drops to undetermined depths, dewatering was accomplished by wellpoints and slab is supported on timber piles driven into silt and sand.

was not favored by the government. This and other considerations determined the selection of a modern under-water tunnel (Figs. 2 and 3).

The planned arterial highway system for Miramar and Vedado required that the Almendares Tunnel follow the route of Linea Street which crossed the river on an old swing bridge formerly utilized by the Havana trolley system and more recently converted to highway use. The bridge and its foundations would have to be removed in their entirety but, to handle traffic during the tunnel construction period, it was planned to reerect the bridge one block upstream.

The swing span was carefully measured and new foundations were constructed at the new site. When the shore approaches and center pier were completed there, the bridge was closed to traffic at midnight and the entire span picked up on two barges and floated one block to its new location. The time required to move the swing span from the old foundations to the new was less than six hours.

Investigations of Soil Conditions

Preliminary investigations of soil conditions for the tunnel indicated that the west or Miramar side differed sharply from the Vedado or Havana side. On the Miramar side the subsoil was found to consist of heavy layers of peat overlying clay and silt, interspersed with unconnected sand and gravel lenses. At approximately the center of the river an outcropping of coral limestone appeared which rose rapidly in several ridges toward the Havana side. Thus half of the tunnel had to be built in a semi-boggy subsurface material and the other half in porous coral rock.

Borings along both sides of the tunnel at 30-ft intervals showed the exact location of the various subsurface materials. Pump tests were made in the test boring holes to obtain some measure of the permeability of the various materials encountered. On the Miramar side a 35 × 35-ft test pit was dug, using wood sheeting, wellpoints, and sump pumps to determine the characteristics of the softer subsoils.

On the Havana or Vedado side, where the coral limestone was encountered, tests were undertaken to determine the hardness, density, and permeability of that rock. A series of pumping test wells were driven along the line of the tunnel, spaced approximately 30 ft apart. On each side of the pumping wells, observation test holes were also drilled. A series of pumping tests, made to determine the drawdown gradient, indicated that the water flowed virtually unchecked through the coral rock and that, with ordinary pumping methods, there was no practical way to successfully dry up the excavation in the rock cut. The porosity of the limestone exceeded 20 percent, indicating that a flow of 1,200 gpm per lin ft of tunnel could be expected.

On completion of the testing program it became evident that the general method of attack would have to be to dry up the Miramar or "soft" side by pumping, and to plug the porous coral limestone on the Vedado side to prevent the inflow of water to the excavation. For this purpose, wellpoints were adopted for the Miramar side and pressure grouting for the Vedado side.

Both approaches to the tunnel were hemmed in closely by privately owned structures. In operations of this sort, where wellpoints are used to dry up the hole, it is customary to step back the excavation to avoid the use of sheeting. The adjacent structures, however, made this impossible on either side of the river. Full-length steel sheetpile cofferdams were accordingly required. Several other considerations weighed heavily in favor of the cofferdam method. In the event that either the wellpoints or the pressure grouting was not entirely successful, the presence of a steel cofferdam would enable the work to be carried on by usual cofferdam methods. The cofferdam was designed with cutoff walls located to isolate troublesome areas without endangering either the safety or the progress of the section.

The construction schedule called for the work to be started on the Miramar side with three lifts of wellpoints. In December 1951 the first lift was installed in parallel trenches approximately 10 ft outside the sheetpiling which formed the cofferdam walls. At the same time pressure grouting was started in the porous coral rock on the Vedado side. The first grout was injected at relatively low pressure along the sides of the tunnel construction from the surface of the rock down to a maximum depth of 25 ft below the tunnel floor, and for a width of 15 ft. Once the grout curtain had been placed along the sides of the tunnel, the rock under the floor of the tunnel was grouted to a thickness of 25 ft using high-pressure methods. These operations are explained in detail by Mr. Prugh and by Messrs. King and Anderson in the two following articles.

At about the same time excavation of the approach was commenced. Because the wellpoints soon drew the water out of the upper level of the ground, sheeting was not required until the excavation had reached a depth of 14 ft. At this point the steel sheetpiles were driven for the entire length of the first stage. Excavation was carried on inside the sheeting to a depth of 20 ft below sea level, which the testing program had indicated could be safely reached with the first lift of wellpoints. Then the second lift of wellpoints was commenced and the water drawn down to a level which permitted relatively dry operation on all but a few deep parts of the work. The third lift of wellpoints permitted all the construction operations to be carried on in the dry.

As the excavation was carried down, steel wales and bracers were installed between the cofferdam walls.

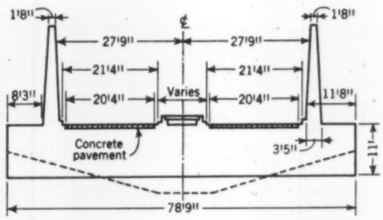

1'8"
1'8"
℄
27'9"
27'9"
21'4"
21'4"
8'3"
20'4"
Varies
20'4"
11'8"
Concrete pavement
3'5"
11'
78'9"

FIG. 2. Approach cross sections are similar except for shape of slab. Flat slab on Miramar side is supported by timber piles. Dashed line indicates Vedado slab.

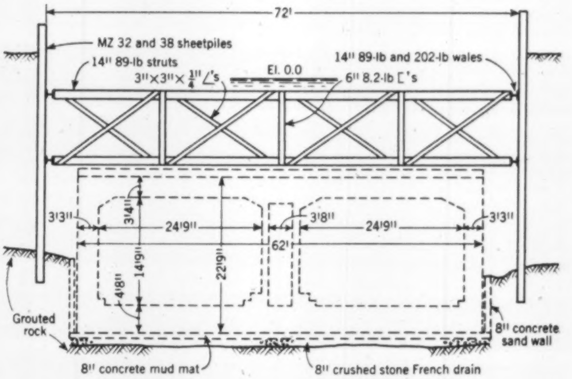
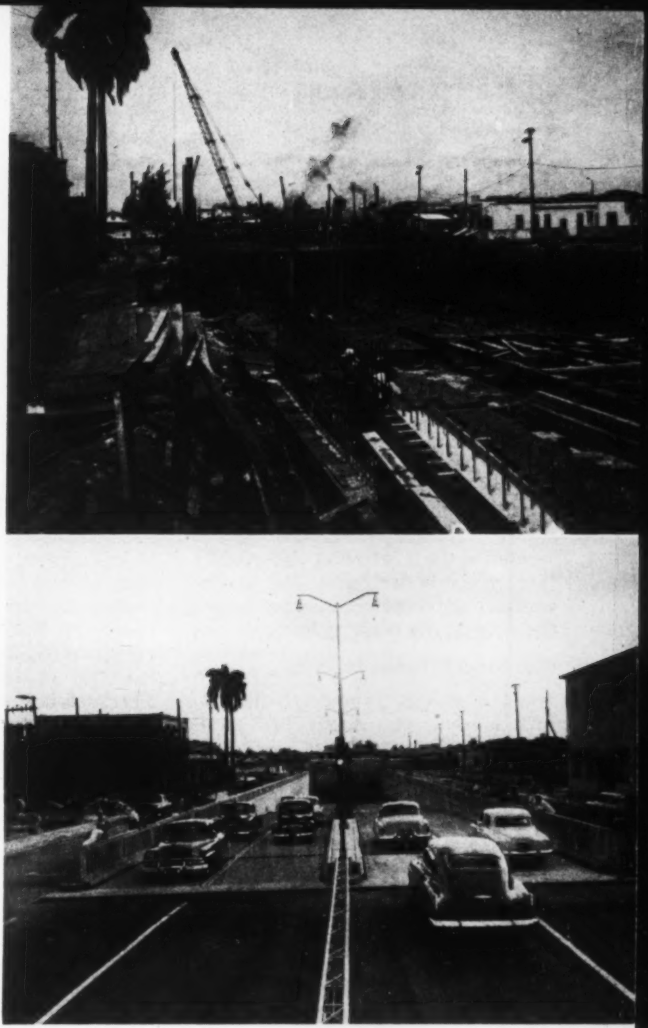
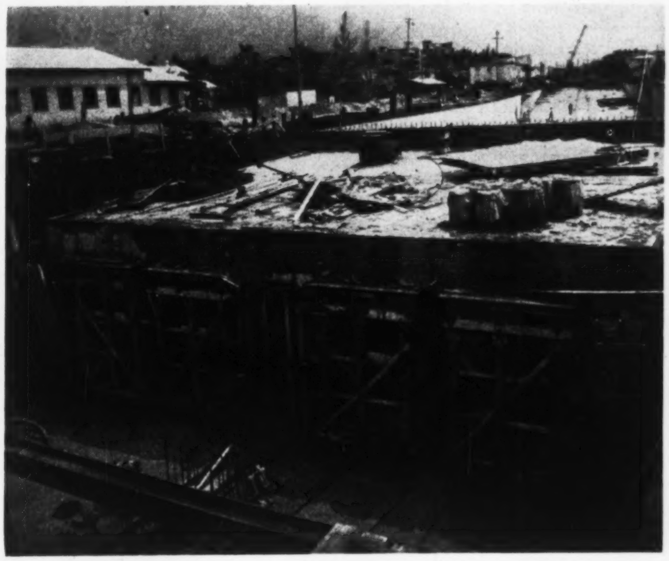

72'
MZ 32 and 38 sheetpiles
14" 89-lb struts
3"×3"×¼"∠'s
El. 0.0
14" 89-lb and 202-lb wales
6" 8.2-lb ['s
3'3"
3'4"
24'9"
3'8"
24'9"
3'3"
62'
14'9"
22'9"
4'8"
Grouted rock
8" concrete sand wall
8" concrete mud mat
8" crushed stone French drain

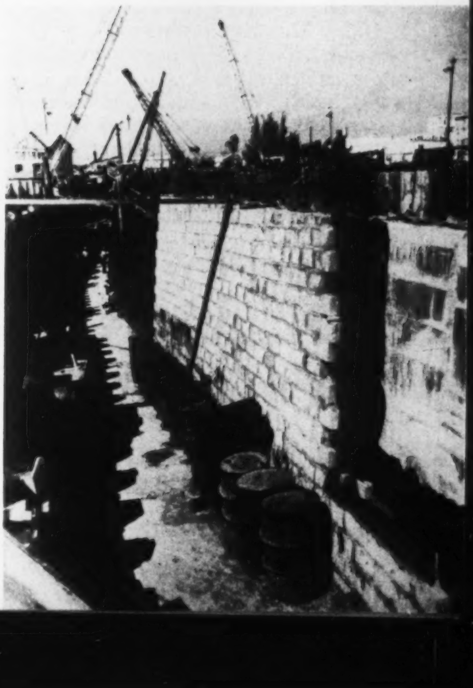
FIG. 3. Typical bracing at tunnel section permits construction in open cut between double row of steel sheetpiling.



Double-lane roadway in each direction carries traffic through tunnel. Two views of Vedado approach show (top) construction inside sheetpile cofferdam after consolidation of porous coral rock by grouting, and (immediately above) finished approach.



Tunnel section was built with movable system of timber forms. Miramar approach can be seen in background.



Bottom slab and exterior of tunnel walls were waterproofed by impervious membrane protected by concrete block wall, here shown being installed.

The bracing varied from one line of wales and bracing in the shallower cuts to as many as four lines in the deepest section of the tunnel. All bracing was installed by prejacking to a stress of 50 tons at each brace point. All connections were butt and fillet welded. Struts were trussed vertically by a system of 6-in. channels and 3-in. angles. Struts were placed on 9 to 10-ft centers to permit the free passage of the clamshell buckets used in excavation (Fig. 3).

Throughout the construction of the cofferdam every attempt was made to standardize wales and bracing. The use of a few standard sections greatly simplified the scheduling and installation of the cofferdam. The bracing was planned so as not to interfere with the permanent construction.

Piles Support Tunnel Structure

As excavation proceeded, the floor was leveled off about to grade. Wherever the tunnel was founded on soft material, wood piles averaging 40 ft in length were driven for structural support. On the upper section of the Miramar approach, wood piles were driven on 5 to 10-ft spacing. As the excavation became deeper and the tunnel loads heavier, the wood piles were driven on 5-ft centers.

When the Miramar cofferdam reached the river bank, a second row of sheeting, parallel to and 40 to 45 ft outside of the first line, was started out from shore on each side of the tunnel. All the soft river-bed material between the rows of sheetpiling was removed, and the space was filled to the top of the sheetpiles with good material to improve the stability of the cofferdam and help seal off the work in the river section. This reduced the amount of pumping and at the same time provided a working area for the equipment used on the central part of the tunnel.

The Miramar cofferdam was extended only to the center of the river to permit passage of river traffic. At this point the usual bulkheading arrangements were provided so that the connection could be made later with second-stage construction. The multiple operations of driving sheetpiles, excavating, driving bearing piles, placing bracing, and many miscellaneous jobs were handled principally by two Lima 802 cranes equipped with 100-ft booms.

After the load-bearing piles had been driven and cut off to grade, an 8-in. concrete mat was poured over the entire area. The mat provided a working surface and a base for the placing of the membrane waterproofing, which was laid across the floor of the mat and up the faces of "sand walls" on both sides of the tunnel. This membrane waterproofing was designed to take the full hydrostatic head of the ground water. Laps were specified to be staggered in order that no two laps in two adjacent plies would occur at the same point. The "sand walls" also effectively controlled and channeled the ground water entering the excavation.

To give additional guarantee of watertightness in the permanent structure, copper water seals were used at all construction joints. In the approach section the sides of the structure were reinforced cantilever walls designed to take the side pressure of the earth. As these were poured and the forms stripped, the membrane waterproofing was carried up along their outside surfaces to within 6 in. of the ground surface. The membrane was protected by a concrete-block wall laid in cement mortar. In the tunnel section, construction was much the same, modified only to the extent made necessary by the change to the double rectangular tube section.

For economy wooden forms were designed for multiple reuse with minimum cutting and fitting. For the approach sections, typical panels were designed so that, with slight additions, they could be adapted to the increased depth. In the tunnel, the wall and roof forms were mounted on travelers to facilitate moving from pour to pour.

Central Mixing Plant Erected

Scarcity of vacant land in the vicinity of the site for the fixed plant and storage area presented a serious problem. No space was available on the Vedado side but permission to use a small park on the Miramar side was obtained. By careful planning suitable yards for forms, steel and repair work were established in the park and a concrete plant was erected. Serious consideration was given to the use of commercial ready-mixed concrete, but it was finally decided to install a 2-cu yd mixing plant which would give complete control over concrete operations. From this plant concrete was available at any hour of the day or night.

Piles were driven to support the concrete plant, which was founded on the soft silt characteristic of the whole Miramar district. Although consideration was given to driving piles to support the sand and gravel storage piles, soil studies indicated that the silt would carry the aggregate if it was not piled over 12 ft high. When piled to this height the load of the aggregates did gradually compact the silt, but there was no accompanying mud wave.

The concrete plant included a 2-cu yd tilting drum mixer and elevated storage bins for 200 tons of stone and sand. Bulk cement was delivered by trailer truck from local mills and stored in a 1,000-bbl silo. A 1 $^1/_2$-cu yd Speed crane serviced the elevated hoppers and a small bulldozer helped stockpile the aggregates, which were delivered by truck. Here also a 20,000-gal water tank was installed to insure a continuous water supply. On a number of occasions the city supply failed in the middle of a pour, and the capacity of the storage tank was taxed before normal water service was restored.

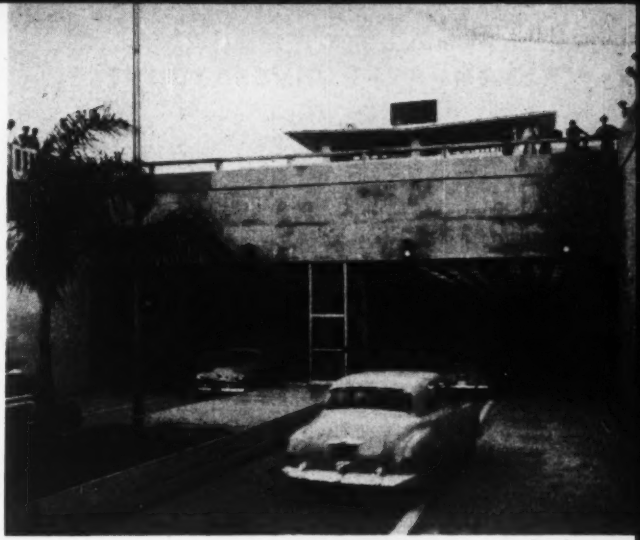
Five Dumpcrete trucks, of 2-cu yd capacity each, transported the concrete from the mixing plant to the work. The concrete was chuted into the forms directly from the Dumpcrete trucks, except on the approach walls, where bottom-dump buckets and a crane were used.

Concrete was placed around the clock, much of it at night. Night concreting operations became important when the work moved to the Vedado cofferdam because heavy vehicular traffic over the two existing bridges made daytime delivery of concrete from the plant on the Miramar side to the Vedado cofferdam uncertain and sometimes impossible.

As the construction work on the Miramar cofferdam approached the river, work on the Vedado cofferdam was started. The grouting program on the Vedado side had been laid out with the objective of forming a U-shaped impervious grout layer which would form the base of the cofferdam and eventually support the permanent tunnel structure. Steel sheetpiles were driven into the rock until they came to bear in the grout-solidified limestone rock.

Inside the cofferdam, rock was excavated by drilling and shooting. The sides of the excavation were line-drilled about 4 ft inside the lines of the sheeting to provide a shelf to hold the toe of the sheetpiling. In some instances the poor quality of the rock at the toe of the sheeting made an additional lower brace advisable. The blasted rock was removed by both clamshell and front-end loader.

When the tunnel section on the Miramar side was completed, the sheetpiling was removed and river traffic was diverted over the top of the finished tunnel structure. The Vedado cofferdam was then pushed out to the transition section in the center of the river and the connection made.



On opening day, April 25, 1953, many cars passed through Almendares River Tunnel, built for Cuban Comision de Fomento Nacional by Raymond Concrete Pile Company of South America.

A considerable part of the excavated material from the Vedado cofferdam was hauled through the completed part of the tunnel. This expedited the remaining excavation by providing ready access and eliminating the necessity of taking all the excavation out through the congested Vedado work area.

Very little water found its way into the Vedado cofferdam through the grouted rock. The greater part of the water entering this cofferdam came from surface material overlying the limestone, and most of the flow of surface water was eventually diverted to the river through special drains installed outside the sheeting. An 8-in. bed of crushed stone placed over the limestone in the bottom of the excavation formed a system of French drains which conducted such seepage as occurred to a series of sumps. Under normal conditions three 8-in. pumps were sufficient to remove the water which seeped into this cofferdam.

The Almendares Tunnel has all the usual facilities found in subaqueous vehicular tunnels. There is a combined rain-water discharge and fire-fighting system, a ventilating system with carbon-monoxide control, and an illuminating system with transition lighting.

Rain water is intercepted at three points in each traffic lane and on each approach by cross-lane floor drains, whence it is conducted to sump wells just inside the tunnel portals. Overflow water from each end sump is fed to the central sump. Fire-fighting lines are controlled by a push button at each fire station, which closes the rain-water discharge lines and starts the pumps that force water through the fire system.

Occasionally the Almendares Tunnel will be completely flooded. The general area in which the tunnel is located is only a few feet above normal high sea level. During a severe hurricane there is every reason to expect that the sea will enter both approaches. During heavy rains in the past the streets in the vicinity of the tunnel have acted as storm drains, forming a channel to conduct storm water directly to the Almendares River at the tunnel site. Corrective works have been constructed to divert the storm water flow from Linea Street but these have not yet been tested by time. Hence the pumping system has a design capacity sufficient to unwater the tunnel. The pumps in the two portal sumps are of 15-hp Johnson deep-well type, driven by electric motors housed in the elevated fan chambers. The pump in the center sump, a 15-hp Jacuzzi submersible turbine type, is driven by a fully enclosed, waterproof-type motor.

There is a ventilating tower at each portal entrance. Ventilation of the tunnel is accomplished by four 75,000-cfm centrifugal Trane fans, two in each ventilating tower. The fans draw the exhaust gases off the ceiling of the two tunnels through the central ventilating or exhaust duct. Fresh air enters at each portal. A carbon monoxide detector and control system by Taller & Cooper has been installed. Carbon monoxide controls, located at three points in the exhaust duct, are set for one half the safe limit for human beings, to allow for air dilution. Normal ventilation can be handled by one fan operating in each tower but an excess of carbon monoxide causes all four fans to operate until the condition is rectified.

The tunnel is lighted by cold cathode continuous-strip fluorescent tubes set against the ceiling. Light is graduated in diminishing intensity from the portals toward the exits to allow the eyes of the drivers to become adjusted to the change. Emergency traffic control lights at each portal entrance are operated by a watchman. Approaches are lighted by overhead lamps set in the dividing island between the main traffic lanes.

Interior walls of the tunnel are finished with glazed ceramic tile; the ceiling is ground-finished concrete, painted sand color to match the tile; and the concrete walls of the approaches have a rubbed finish. The railing along the approaches was precast in sections, set and concreted into place.

Field operations commenced in November 1951, and work was pushed on a three-shift basis until completion in February 1953. The contractor's administrative and principal technical personnel came from the United States. An average of 24 Americans served on the work. The rest of the administrative and technical staff, as well as all the labor, was Cuban. On the average approximately 390 Cubans were employed on the project.

Major quantities for Almendares Tunnel

Cofferdam steel		
Z-section sheetpiling		1,750 tons
14-in. 89-lb BP-section wales		700 tons
Excavation		
Dry earth	8,000 cu yd	
Wet earth	63,500 cu yd	
Rock	28,500 cu yd	
Total		100,000 cu yd
Concrete		45,000 cu yd
Reinforcing steel		1,265 tons
Waterproofing		228,000 sq ft
Pitch		882,000 sq ft
Impregnated fabric		275,000 sq ft
Mortar		1,840 cu yd
Seal grouting		
Drilling		30,000 lin ft
Pipe casing set 2½ in.		24,500 lin ft
Grout		252,000 cu ft
Ceramic tile, 4¼ × 4¼ in.		33,000 sq ft

The Almendares Tunnel was constructed by the Comision de Fomento Nacional of Cuba under the technical direction of Chief Engineer Jose Menendez Menendez. Engineer Manuel Ray Rivero was resident engineer. Construction engineers and general contractors were the Raymond Concrete Pile Co. of South America. Arthur Fertell was project manager, Dan Wilson the superintendent, and Duff Williamson resident engineer. The Prepakt Co. was subcontractor for the pressure grouting, and the Moretrench Co. for the wellpoints.

(*This article is based on the paper by Mr. Boschen presented as part of the Construction Division symposium on the Almendares Tunnel at the ASCE Miami Beach Convention. At this session Warren N. Riker, chairman of the Division's Program Committee, presided.*)

Miramar cofferdam dewatered by wellpoints

BYRON J. PRUGH, A.M. ASCE, Assistant Chief Engineer, Moretrench Corp., New York, N.Y.

Use of wellpoints to dewater the Miramar side of the Almendares Tunnel produced a dry bottom in the excavation and reduced pressures on the sheetpile cofferdam so that the open-cut method of construction could be used despite difficult soil conditions. Because of the reduced lateral and uplift pressures, a minimum amount of bracing of a simplified, uniform design, was required. An uncongested and dry working area, free of the usual multitude of braces, materially increased the progress and efficiency of the work. Wellpoints insured that there would be no loss of material or disturbance of the natural ground due to "boiling."

The tunnel was correctly located for performing its function, but the subsurface conditions at the site left much to be desired. Preliminary investigation showed that the west or Miramar side consisted of layers of pervious and impervious material, and the Vedado side primarily of coral limestone.

Pumping Tests Made

A Moretrench wellpoint system, designed for adaptability under changing field conditions, was sent to Cuba in October 1951 to test the soils at the tunnel site, which varied from silts through very coarse sands and gravels. The equipment included two 6-in. gasoline-powered wellpoint pumps and one 6-in. Jet-Well pump, together with 400 ft of header pipe and 125 wellpoints.

The first installation was made around an open-cut test pit 35 ft square located 100 ft west of the Miramar portal. Water was lowered 13 ft by pumping 1,800 gpm, which included a large volume percolating through the overlying 7 ft of very coarse fill. Then a second, double-sheeted test pit, 35 ft square, was constructed to a depth of 35 ft about at the Miramar portal. Piezometers were placed in line with these test pits along the center line of the proposed structure.

From the pumping tests at these two pits, the very pervious strata were located and the drawdown curves for them determined for various pumping rates. A maximum volume of about 30 gpm per wellpoint was obtained. A major coarse pressure layer was located near El. −35. Later this was found to be a tongue-like layer which extended out into the river. Although the ground varied throughout the length of the tunnel, it generally could be classified into the five layers shown at the left in Fig. 1.

Three Lifts of Wellpoints Installed

As a result of the pumping tests, wellpoints were initially installed for dewatering the tunnel excavation west of Station 52+0. This equipment was shipped from New York, and work was started in the middle of December 1951.

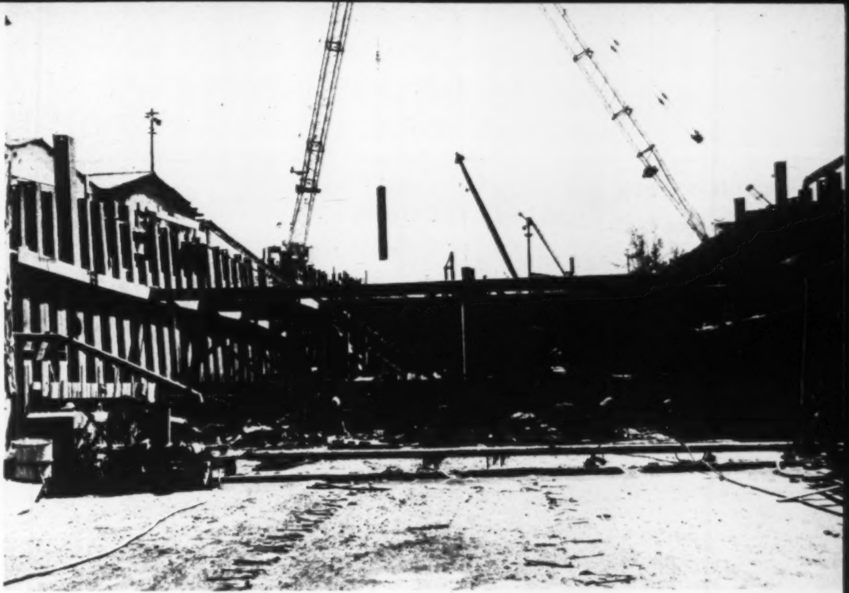
The first wellpoint header pipe was installed about 10 ft below the normal groundwater level of El. −4. This was done by using the test equipment in the sheeted test pit to lower the water level enough so that a trench could be excavated for the header pipe and wellpoints. A typical cross section near the Miramar portal is shown in Fig. 1.

After dewatering, the first section of the tunnel was excavated by the open-cut method to a depth of 14 ft before sheeting was installed. The trench for the header pipe was dug outside the proposed sheeting line with banks steeply sloped because of the stability of the dewatered fill. This fill, consisting of sand, cinders, gravel, wood, timbers, bricks, ashes and old Belgium paving blocks, was so porous that at high tide two large sheeted sumps were required to handle the inflow and maintain the steeply sloped banks. These sheeted sumps were also required during the frequent heavy tropical rain storms which funneled flood water into the naturally low-lying tunnel location.

The upper system of header pipe was tied together with crossovers at each end. Four 10-in. diesel-powered pumps, including spare pumps, discharged about 4,000 gpm from the 700 ft of header pipe. A second ring of header pipe was installed at El. −20 but on the inside face of the steel sheeting (see Fig. 1), lowering the water level inside the sheeting to subgrade.

To install the wellpoints in the laminated soil, a special casing, 18 in. in diameter and 45 ft long, called a "holepuncher," was first jetted into the ground using compressed air and water. Immediately after the holepuncher was withdrawn, a wellpoint was self-jetted into the hole to the desired elevation. Graded filter sand was placed around each wellpoint.

In February 1952, because of the successful dewatering of the west part of the tunnel, it was decided to extend the wellpoints to a location about at a point where the excavation line intersected the rock line. This was accomplished by extending the lower header along the inside face of the steel sheeting but necessitated placing the upper header on the inside of the outer row of sheetpiles in the river cofferdam, as shown in Fig. 2. To



In single-wall approach cofferdam on Miramar side, wellpoints were installed both inside and outside of sheetpiling, maintaining a pressure differential of not more than 15 ft. This kept working area dry and uncongested and simplified bracing system. Electric wellpoint pump is on sheeting at right, and diesel pump is at left.

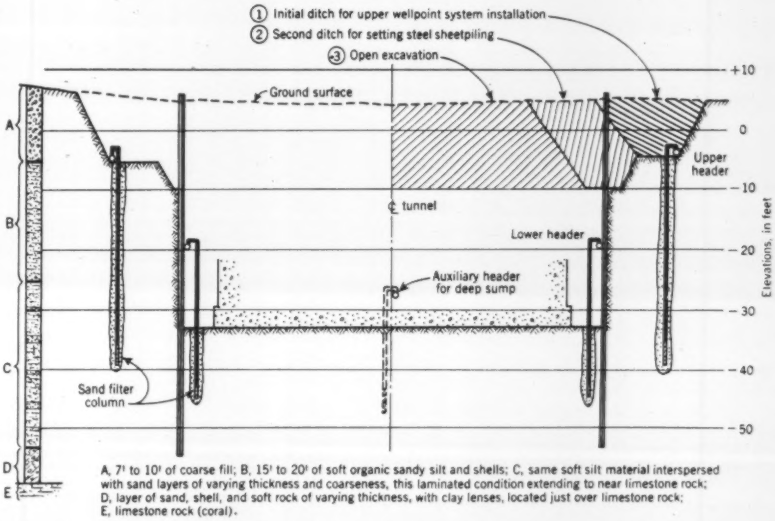
dewater the west sump, a third small auxiliary setup of wellpoints was installed at El. −30.

The maximum volume of water pumped from the wellpoint system at any one time was 6,000 gpm, but when this quantity was reached, about 400 ft of header and wellpoints had already been removed from the completed approach section. Throughout the job 10 and 12-in. header pipe and pumps were used. Of the nine diesel- and electric-powered wellpoint pumps, two were used as sump pumps for the excess tidal and rain water.

Piezometers, placed at strategic locations about 100 ft apart, both inside and outside of both lines of steel sheeting, were read daily as well as at critical periods such as at extremely high tides. Generally the pumps were operated to maintain a differential pressure between the inside and the outside of the sheeting of from 10 to 15 ft of water.

One of the problems encountered in the operation of dewatering by wellpoint was the corrosion of the header, wellpoints and pumps, especially in areas of turbulence such as elbows and the moving parts on the pumps. Analysis of the water, which was very saline, showed that the trouble was caused by a high hydrogen sulphide content running from 50 to 100 ppm. On equipment installed during the latter part of the job, parts affected were protected by special coatings.

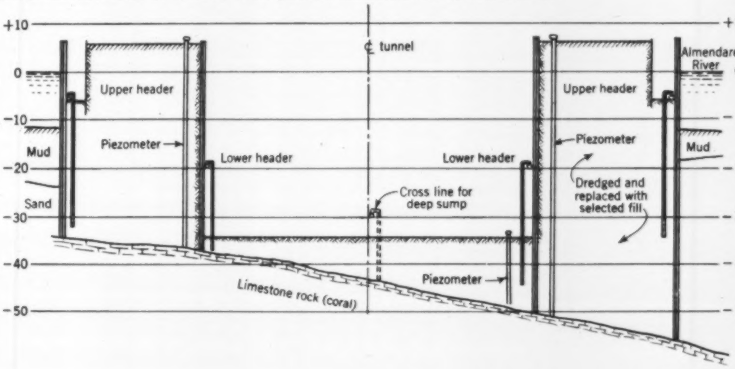
(This article is based on the paper by Mr. Prugh presented as part of the Construction Division symposium on the Almendares Tunnel at the ASCE Miami Beach Convention. At this session Warren N. Riker, chairman of the Division's Program Committee, presided.)


① Initial ditch for upper wellpoint system installation
② Second ditch for setting steel sheetpiling
③ Open excavation
Ground surface
+10
0
−10
−20
−30
−40
−50
Upper header
℄ tunnel
Lower header
Auxiliary header for deep sump
Sand filter column
Elevations, in feet
A
B
C
D
E

A, 7' to 10' of coarse fill; B, 15' to 20' of soft organic sandy silt and shells; C, same soft silt material interspersed with sand layers of varying thickness and coarseness, this laminated condition extending to near limestone rock; D, layer of sand, shell, and soft rock of varying thickness, with clay lenses, located just over limestone rock; E, limestone rock (coral).

FIG. 1. Typical section through single-wall cofferdam near Miramar portal shows character of subsoil and location of wellpoints and headers.

FIG. 2. Section through double-walled river portion of cofferdam shows wellpoint system near intersection of tunnel with porous limestone rock formation.


+10
0
−10
−20
−30
−40
−50
℄ tunnel
Almendares River
Upper header
Upper header
Piezometer
Piezometer
Mud
Mud
Lower header
Lower header
Sand
Cross line for deep sump
Dredged and replaced with selected fill
Piezometer
Limestone rock (coral)
Elevations, in feet

JOHN C. KING, A.M. ASCE
Chief Engineer

JOHN R. ANDERSON
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Intrusion-Prepakt, Inc., Cleveland, Ohio

Intrusion grouting seals

The Almendares Tunnel, constructed in open cut within the confines of a steel sheetpile cofferdam, afforded an unusual opportunity to demonstrate the effectiveness of grouting procedures for sealing highly permeable foundation material. Results bordered on the spectacular.

The writers' company was engaged initially to determine whether Intrusion grouting materials and methods would provide an effective seal against inflow of water through the foundation rock. On successful completion of this test, a contract was awarded to Intrusion-Prepakt, S.A., for the solidification of the bedrock formation against inflow to the cofferdam in which the major part of the tunnel section and the Vedado approach were to be built.

Porous Coral Limestone Tested

Pleistocene coral and coral limestone constitute the geologic structure on which about two-thirds of the tunnel and all of the Vedado approach are founded. This rock is covered in the Vedado approach area with from 15 to 30 ft of unconsolidated silty clay with intermingling layers of sand. In the channel area, the rock is covered with from 5 to 12 ft of the same material. In the vicinity of the Miramar bank of the river, the rock surface drops sharply to undetermined depths, making it plausible to suppose that downfaulting has occurred in this area (Fig. 1).

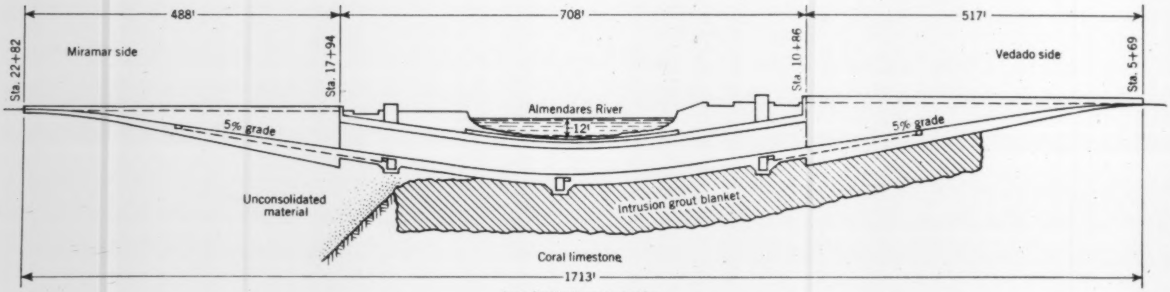
The upper stratum of the coral formation, from top of bedrock to El. −40, is moderately fresh in appearance and shows little evidence of any serious weathering. Solution agents have been active through most of this zone, softening vug walls and surfaces of numerous fracture planes and enlarging fossil voids. It is estimated that voids in the formation exceed 20 percent.

Below El. −40 the coral limestone is weathered and oxidized. In it voids are numerous, ranging in size up to 4 in. across. One large cavity discovered was 12 ft deep. Most of these voids are filled with a blue plastic clay.

The site selected for the foundation test grouting was located within the Vedado approach. Before the test, a 20 × 20-ft cell of matched wood sheeting was driven 20 ft to rock and excavated half way. A 10 × 10-ft cell was then installed within the larger one and excavation carried to rock. Test grout was injected through holes drilled to a depth of 20 ft below the rock surface and on 5-ft centers in a rectangular pattern straddling the test pit.

The test pit treatment indicated that water in the foundation bedrock could be successfully controlled by Intrusion treatment methods. Before the grouting treatment, 800 gpm of water was pumped out to hold the water down to the top of rock in the test pit. After treatment, only 30 gpm had to be pumped to keep the pit empty, most of this water being seepage through the untreated overburden and the pit-lining timber.

The test showed also that a pattern of holes on 20-ft centers, followed by a second pattern on 10-ft centers would be adequate under the job cofferdam, with relatively few holes of the third pattern at 5-ft intervals for check purposes or for the treatment of special areas. The unit grout consumptions for the first, second, and third patterns were 23.0, 17.7, and 4.64, respectively (in cu ft



Longitudinal cross section

porous coral rock for Vedado cofferdam

of grout per lin ft of holes), which represents a reduction in consumption of almost 24 percent from the first to the second pattern, and a 73-percent reduction from the second to the third pattern.

On the basis of the information developed during the test program, definite design and treatment procedures were established before field operations were started. From this standpoint alone the test work was well worth while.

The Major Program

The foundation area treated extended lengthwise of the tunnel from near 22nd Street on the Vedado (Havana) approach to 0 Street on the Miramar side, a distance of approximately 750 ft. Laterally it extended over the full width of the cofferdam plus an additional 10 ft beyond the sheetpiling on each side, as shown in the transverse cross section, Fig. 2.

The depth of treatment below the excavated grade was specified to be at least one-half the depth of water at the section. To completely seal the area with a minimum of grout holes, the grouted zone was actually made about 20 ft thick under the approach area and 25 ft thick under the tunnel.

The grout-hole pattern and sequence of grouting operations to accomplish this required careful planning. A layout of grout holes and a sequence of grouting were devised to produce a uniform distribution of grout throughout the area and to fill all open voids and cavities without trapping or isolating zones of water which might later develop into a weak spot in the blanket.

To confine the grout to the cofferdam area, high- and low-pressure grout curtains were located parallel to, but outside of, the steel sheetpiling at distances of 5 and 10 ft, respectively. The hole spacing for each curtain was 10 ft, with the holes in one line opposite the midpoints of the spaces in the other line. This grout curtain extended the full length of the cofferdam on each side and diagonally across near 0 Street, on the Miramar end of the tunnel. Transverse curtains were also placed at Stations 12 + 60 and 14 + 00 at anticipated cofferdam diaphragm locations.

The grout-hole layout within the limits of the cofferdam was arranged for three phases of treatment. First-phase holes were located on a 20-ft grid system while second-phase holes were placed in the centers of the squares formed by the primary pattern. A few third-phase holes were drilled to determine the effectiveness of the first and second phases of treatment and where additional treatment was needed.

Drilling, Washing, and Grouting Sequence

All drilling and grouting operations were performed from the surface of the ground or through the water from barges in advance of the driving of the sheetpiling. The low-pressure grout-retaining curtain was started first, and when this was well under way, work on the high-pressure curtain was started. First-phase blanket grouting at low pressure followed at an appropriate interval, and this in turn was followed by second-phase drilling and grouting. This sequence provided excellent control of the distribution and movement of grout and, with minor exceptions,

FIG. 1. All of Vedado approach and two-thirds of tunnel proper were founded on extremely porous coral rock, through which water flowed freely.

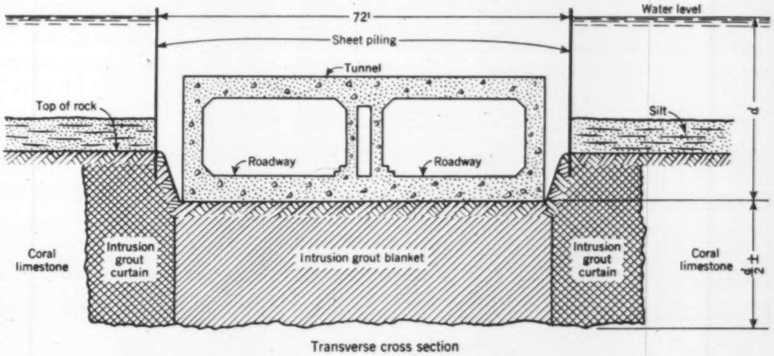


FIG. 2. Intrusion grout curtains on each side and blanket below enabled cofferdam to be successfully dewatered and all work done in the dry.

Drilling and grouting of foundation rock proceeds in river area from barge, ahead of cofferdam extending out from Miramar shore. Grouted zone under tunnel was made about 25 ft thick.

was used throughout the work. By advancing the blanket treatment uniformly in one direction, trapping of water within the area was avoided.

Drilling operations began by driving 2 1/2-in. casings to refusal through the unconsolidated overburden, usually to a penetration of 1 to 3 ft into bedrock. When a casing had been satisfactorily positioned, a grout hole was drilled through it to the desired depth. In the softer zones, particularly under the river, 2 1/2-in. fishtail bits were used for drilling; in the harder formations, AX (1 7/8 in.) diamond plug bits were employed.

All grout holes were pressure washed. This was done by alternately blowing air and water through alternate holes to return through adjacent ones, and then by reversing the direction of flow. Thus the air and water were blown back and forth through the rock until the desired results were obtained.

Grout frequently flowed in the rock between holes in the curtains and in the first-pattern phases of treatment. The sequence of treatment was arranged so that the most open connections would be grouted next.

Grout Pressure Varied

Injection pressure was determined by several factors: resistance encountered at the hole, consistency of mix, rate of injection, and rate of grout acceptance. The average maximum pressure used on the low-pressure curtain holes and first-phase blanket holes was 150 psi; on the high-pressure curtain holes, and second- and third-phase blanket holes, 225 psi. As much as 400 psi was recorded at the time of refusal on many holes, but such pressures were applied only after all major voids had been sealed and the active pressure area had been reduced to a minimum. As far as could be determined, there was no deformation in the bedrock zone during the period of treatment, although uplift occurred in a few areas when grout leaked into the overburden, and at the Miramar end of the treated zone, where unconsolidated material only was encountered.

Each hole was grouted by an individual pump and a single non-recirculating line. With this equipment the consistency and pressure of the grout could be suited to the condition of the hole, so that the "take" would be a maximum and so that grout leakage could be more easily detected and controlled. The "pooling" of liquid masses which might develop uplift was prevented by spacing the holes that were being grouted simultaneously as far apart as possible.

At the beginning of pumping operations, the grout was made up in the proportions of 1 bag cement, 1 bag Alfesil, and 28 gal water, which was called a "batch." Approximately 15 to 20 batches of this mix were pumped, and then, if there was no appreciable pressure rise, a second bag of cement was included in each batch. Further reductions in water content were made at the end of each 15 to 20-batch pumping period until the pressure began to build up or until the mix had been thickened to the proportions of 2 bags cement, 1 bag Alfesil, 5 cu ft sand, and 19 gal water. As a matter of fact, the sanded mix was used infrequently.

In addition to Alfesil, all grout mixes used in this work contained Intrusion Aid in the amount of 1 percent of the weight of cement plus Alfesil. Intrusion Aid, when used in appropriate, small quantities, imparts to the grout mixture the properties of a colloidal suspension, reduces the water requirement for equal fluidity, delays the early stiffening of the grout fluid, and reduces or eliminates the setting shrinkage noted during the hardening of cement-water pastes. Alfesil is the trade name for a very finely divided siliceous material which reacts with the lime liberated during the hardening of the portland cement to form insoluble, strength producing compounds. Without detracting in any way from the obvious skill and competence of the personnel who conducted the work, it is believed that the inclusion of these admixes made possible the use of the single-line grout-supply system and contributed materially to the thorough penetration of the grout into the rock and to the success of the work.

Dry Cofferdam Produced

The number of holes cased, drilled, and grouted was 760. These operations required the drilling of 30,300 lin ft of hole, of which 22,600 lin ft were grouted, the difference representing the footage of hole between bottom of casing and top of grouted zone. The fluid volume of grout

Foundation grade, 38 ft below river surface, is dry as forms are set for tunnel section, above. At right, discharge from pump represents all the water that is getting into this cofferdam through both sheetpiling and grouted foundation rock.

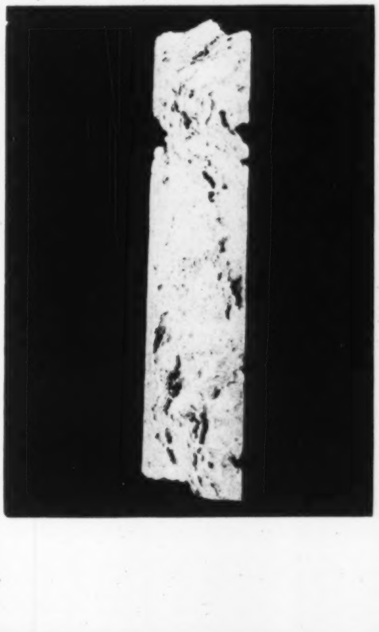
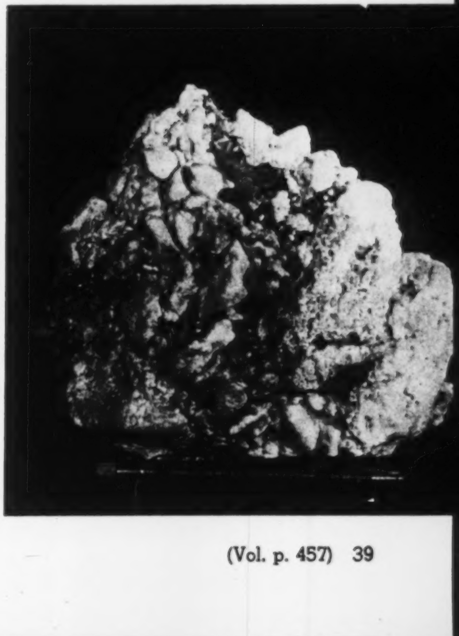
mixed and pumped was 344,000 cu ft, which required 99,900 sacks of portland cement, 66,300 sacks of Alfesil, and 165,900 lb of Intrusion Aid. Sand, which was included occasionally, amounted to 5,400 cu ft. Average grout consumption was 453 cu ft per hole, or approximately 15.2 cu ft per lin ft.

Following the Intrusion grout treatment, the sheetpile cofferdam was driven and the enclosed material was excavated to grade. Inflow through the grouted areas, after excavation had reached a depth as great as 38 ft below the river surface, was less in quantity than the leakage through the well-placed sheetpiling. All inflow was easily controlled with a small amount of pumping equipment. The amount of grout which appeared with the rock in the bottom of the excavation was remarkably small and never sufficient to increase the work of excavation.

The excellent cooperation between the engineers and construction personnel of the owner, the prime contractor, and the subcontractor contributed greatly to the success of the work. General supervision was exercised by Ing. Jose Menendez Menendez, Chief Engineer, and Ing. Manuel Ray Rivero, Resident Engineer, for the Comision de Fomento Nacional, Republic of Cuba, the owner; by Arthur Fertell, project manager for the Raymond Concrete Pile Co. of South America, prime contractor; and by Lee Turzillo, Vice President, Intrusion-Prepakt, S.A., the subcontractor responsible for drilling and grouting. Dale Michael was field superintendent in direct charge of the subcontractor's forces, while John R. Anderson provided the field engineering, including responsibility for design layout and quality control. Conception and preliminary planning of the grouting treatment should be credited to Warren N. Riker, M. ASCE, chief engineer for the prime contractor, and to the senior author of this article. The Frederick Snare Corp. was retained as consultant by the owner.

(This article is based on the paper by Messrs. King and Anderson, presented as part of the Construction Division symposium on the Almendares Tunnel at the ASCE Miami Beach Convention. At this session Warren N. Riker, chairman of the Division's Program Committee, presided.)

Core samples such as that at left below, plus pumping tests, convinced all concerned that unwatering of cofferdam founded on porous coral limestone would present difficult problem. But after grouting by Intrusion-Prepakt method, voids were filled as seen in typical piece of grouted rock at right, and unwatering of cofferdam was easily accomplished.

Miami tackles multi-faced pollution problem

E. SHERMAN CHASE, M. ASCE

Partner, Metcalf & Eddy
Boston, Mass.

When I start to discuss the sewage disposal problem of Miami, the words of Hamlet come to my mind:

> There are more things in heaven and
> earth, Horatio,
> Than are dreamt of in your philosophy.

This thought arises because of the multi-faced aspect of the Miami problem—psychological, political, financial, recreational, as well as engineering. To appreciate these facets, it is essential to outline the background of Miami's development.

Miami had its beginning on the site of old Fort Dallas built near the mouth of the Miami River in 1836 during the Seminole Wars. After the extension of the Florida East Coast Railway to Miami, the city was incorporated on July 28, 1896, with a population of about 300. By 1920 the population had reached 29,571. It had increased to 110,637 ten years later, and to 172,172 by 1940. Although the rate of growth decreased during the war years, the population continued upward largely on account of the influx of families of men in the military service. By 1945 it was 192,122. Since the war there has been an accelerated increase, reaching 249,276 according to the 1950 federal census.

Because of favorable location and climate, the initial development was principally as a tourist resort. Miami has a mean annual temperature of 75.4 deg F, with an average of 66.5 deg in the coldest month, and 81.4 deg in the hottest. The average annual rainfall is 59.5 in., but most of the precipitation occurs between May and October, leaving the winter months clear and sunny. Prevailing winds are from the east and southeast.

Although its physical development and appearance are generally typical of a resort area, the city provides employment for a substantial part of its large permanent population through diversified activities in business, manufacturing, commerce, and the construction industry.

Climatic considerations are also of importance in attracting light industry because of favorable working conditions. While there is practically no heavy industry, the increase in the field of light manufacture and allied industries has been noteworthy. In 1935, there were 198 manufacturing plants in the metropolitan area, and at present there are over 1,000 providing such consumer goods as printing products, bakery items, beverages, wearing apparel, boats, and furniture.

As a result of the rapid growth of the city, the construction business is a large source of employment and an important economic factor. Miami also ranks high as a retail trade center, having many more service trade establishments than the average city of equal population. In addition, the area has become the center of a vast aviation industry which involves an annual expenditure of $100,000,000 and employs approximately 17,000 persons. The marine industry is another important economic factor with annual expenditures of more than $49,000,000 and more than 10,000 employees. Thus it is seen that the trend today is increasingly in the direction of diversity, but the tourist business remains the largest business and probably the greatest source of income for the city.

The average elevation of the city is approximately 10 ft above sea level and the maximum 22 ft. Practically the entire area is level and natural drainage is almost wholly through seepage into the porous underlying strata. A few artificial channels have been built, mainly to drain low lands to the west.

Before the drainage channels were constructed, the coastal rock ridge paralleling Biscayne Bay tended to divert storm runoff to the Everglades in a southerly direction. Natural breaks in this ridge were few, the most important being the Miami River, a narrow, shallow stream bisecting the city. After the drainage canals were cut and the Miami River deepened, there followed a substantial increase in the discharge of highly colored water from the Everglades into Biscayne Bay.

The area is underlain by a soft, very porous lime rock known as Miami oolite, which is 20 ft or more thick and outcrops in many places. Except for the outcrops, the rock is covered by a thin layer of sand 1 or 2 ft in depth or, somewhat infrequently, by muck or marl. Under the oolite is a stratum of very fine sand followed by layers of sand and sandy limestone.

The porous nature of the subsurface formations, the low ground elevation and the high water table involve much difficulty and high cost for sewers and other underground structures. Nearly all sewage must be pumped for discharge to the bay or river, in some cases more than once.

Miami has two sewer systems, one carrying sewage, the other stormwater. The first sewer was laid in Flagler Street in 1906. Additions to the system have been made from time to time until at present about 200 miles of sewers serve somewhat more than 55 percent of the all-year population. There are 22 existing pumping stations, all but one automatically controlled. The sewage is at present discharged without treatment through seventy outlets into Biscayne Bay, Miami River, and Little River.

The unsewered area is served by septic tanks and cesspools which are reasonably satisfactory in thinly settled areas but which will undoubtedly create unsatisfactory conditions as the city grows and density of population increases. Obviously, the percentage of sewer-connected population will increase, requiring future extensions to the sewer system.

The sewage of approximately 230,000 people now living in the city during the winter months goes untreated into the rivers and bay along the waterfront. This estimate of current sewered population is based on present all-year and winter populations of 280,000 and 350,000, respectively, with about 55 percent of the all-year population and about 65 percent of the total winter population connected to the sewers.

The contents of the septic tanks and cesspools serving the remainder of the city's population, when removed by

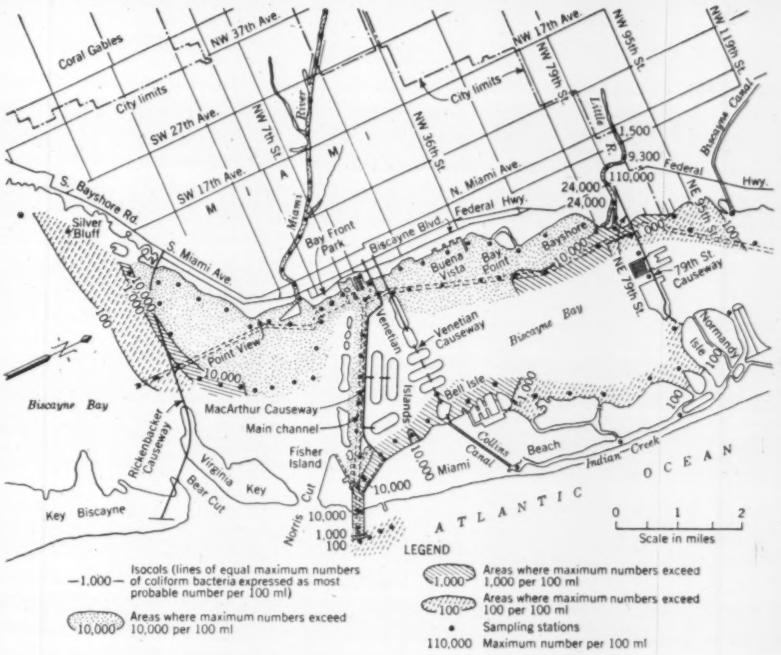

Coral Gables
City limits
NW 37th Ave.
SW 27th Ave.
SW 17th Ave.
NW 7th St.
Miami River
M I A M I
NW 36th St.
NW 17th Ave.
NW 79th St.
NW 95th St.
NW 119th St.
Little R.
Biscayne Canal
Federal Hwy.
N. Miami Ave.
NE 79th St.
79th St. Causeway
S. Bayshore Rd.
Silver Bluff
S. Miami Ave.
Bay Front Park
Biscayne Blvd.
Buena Vista
Bay Point
Bayshore
Point View
Venetian Islands
Venetian Causeway
Biscayne Bay
MacArthur Causeway
Main channel
Fisher Island
Norris Cut
Rickenbacker Causeway
Virginia Key
Bear Cut
Key Biscayne
Bell Isle
Collins Canal
Miami Beach
Indian Creek
Normandy Isle
ATLANTIC OCEAN
1,500
9,300
110,000
24,000
10,000
1,000
100
0 1 2
Scale in miles
LEGEND
—1,000— Isocols (lines of equal maximum numbers of coliform bacteria expressed as most probable number per 100 ml)
10,000 Areas where maximum numbers exceed 10,000 per 100 ml
1,000 Areas where maximum numbers exceed 1,000 per 100 ml
100 Areas where maximum numbers exceed 100 per 100 ml
● Sampling stations
110,000 Maximum number per 100 ml

FIG. 1. Bacterial analyses of water surrounding Miami, made May–September 1949, show extent of pollution at flood tide. Shaded areas indicate density of coliform bacteria. This isocol map of Biscayne Bay and tributaries is based on data furnished by Florida State Board of Health.

cleaning contractors, are dumped into a sewer which discharges directly into the bay at the docks where the Miami-Havana passenger vessel, and other ocean-going passenger vessels, berth. There is also some pollution from the population living on boats.

In 1949, the Florida State Board of Health made a careful sanitary survey of Biscayne Bay and of the Miami and Little rivers. This survey disclosed visual evidence of gross pollution along the waterfront and out into the bay. It was concluded that unless active steps were taken, conditions would continue to deteriorate with further threats to public health and with an adverse effect on the economic, esthetic, recreational and commercial interests of the metropolitan area.

During this survey, many bacterial analyses of bay waters were made. From the results of these analyses, it was concluded that on the flood tide no waters were suitable for bathing in the area from just north of the 79th Street Causeway to a little south of Rickenbacker Causeway along the Miami shore, in the main channel out through the jetties, and in the area along the Miami Beach shore from the main channel to north of Sunset Islands (Fig. 1).

Following this report, the city recognized the seriousness of the situation and in 1950 retained the Miami Sewer Project Associates to report on and prepare plans for the abatement of the pollution of Biscayne Bay and adjacent waters. This group consisted of Maurice H. Connell and Associates, Inc., of Miami; Rader Knappen Tippetts Engineering Co. (now Rader Engineering Co.), also of Miami; and Metcalf & Eddy of Boston.

The program proposed by the then Associates consists of intercepting sewers to collect all sewage now reaching the existing sewers, and of ample capacity to serve extensions to the sewer system, the sewage so collected to be delivered to two main pumping stations, one east of Biscayne Boulevard near N.E. 9th Street, and the other near the Miami River in the vicinity of N.W. 4th Street. From these stations the sewage would be pumped across Biscayne Bay, a distance of about $2^3/_4$ miles, to a treatment plant on the northerly end of Virginia Key. The purified effluent from the treatment plant would be discharged through an outfall and dispersed in the ocean about one mile from shore (Fig. 2).

Determination of the future population of Miami required a study of

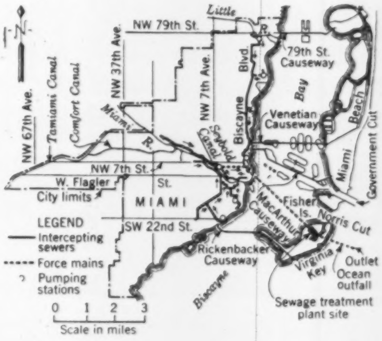

N
NW 79th St.
Little R.
79th St. Causeway
NW 67th Ave.
Tamiami Canal
Comfort Canal
NW 37th Ave.
NW 7th Ave.
Biscayne Blvd.
Bay
Venetian Causeway
Miami Beach
Government Cut
Miami R.
Seybold Canal
NW 7th St.
W. Flagler St.
City limits
M I A M I
SW 22nd St.
MacArthur Causeway
Fisher Is.
Norris Cut
Rickenbacker Causeway
Virginia Key
Outlet Ocean outfall
Sewage treatment plant site
Biscayne
LEGEND
Intercepting sewers
Force mains
Pumping stations
0 1 2 3
Scale in miles

FIG. 2. Plan proposed for abatement of pollution in Biscayne Bay and tributaries includes construction of interceptor sewers to collect from existing sewerage system, pumping stations, trans-bay force main, treatment plant on Virginia Key, and ocean outfall one mile long. Bid prices totaled $22,056,906.28. System is designed to handle ultimate load of 153 mgd.

TABLE I. Forecast of total and sewered populations of Miami

	Permanent Residents		Transients		Total	
	Total	Connected to Sewers	Total	Connected to Sewers	Total	Connected to Sewers
1965:						
Annual av.	350,000	260,000	22,500	20,000	372,500	280,000
Winter max.	350,000	260,000	90,000	80,000	440,000	340,000
1980:						
Annual av.	400,000	360,000	25,000	25,000	425,000	385,000
Winter max.	400,000	360,000	105,000	105,000	505,000	465,000

TABLE II. Low bidders and bids for five contracts of proposed program

Contract	Structures	Low Bidders	Bid Price
1	Intercepting sewers	W. T. Price Dredging Co., Miami, Fla.	$6,719,847.90
2	Pumping stations	DeFonce Construction Co., Bridgeport, Conn.	2,454,160.00
3	Force main across Biscayne Bay	Merritt, Chapman & Scott, New York, N. Y.	1,988,878.00
4	Treatment plant	Paul Smith Construction Co., Miami, Fla.	9,216,559.00
5	Ocean outfall	Diamond Construction Co., Savannah, Ga.	1,677,461.38
		Total	$22,056,906.28

its past growth and the factors involved in it, as well as of the factors that may control future development as previously discussed.

Both the Florida Power & Light Co. and the Southern Bell Telephone Co. have made extensive studies of population trends for the Dade County area. In addition, the Statistical Exchange of South Florida, which serves a large group of business interests in the area, has done considerable work, under the direction of Dr. Reinhold Wolff of the University of Miami and Director of the Statistical Exchange of South Florida. These forecasts naturally did not coincide exactly with the areas to be served by the sewerage project. However, they have served as aids to judgment in forecasting the populations that may reasonably be expected to contribute to the sewerage system. See Table I.

In planning the capacities of the component parts of the proposed sewerage works, the winter increase in population had to be considered. A number of homes are used only by winter residents. Numerous families are visited by friends and relatives, while others rent rooms, and in many cases houses occupied by permanent residents are rented to winter visitors, frequently with an increase in the number of occupants. Hotel and apartment house accommodations are available for large numbers of tourists, and many accommodations are available in tourist homes, tourist courts, and trailer parks. Although the city of Miami provides accommodations for only a part of the tourists who arrive in the area, many who find quarters outside the city avail themselves of city facilities for trading, eating, and amusements and thus increase the load on public utilities.

To collect sewage from that part of Miami now provided with sewers, several intercepting sewers having a total length of about 16 miles would be required. These proposed interceptors would vary in diameter from 12 in. to 72 in., the smaller diameter being at the upper end of a branch interceptor. These interceptors would be of ample size to take a maximum flow of 153 mgd from a total connected population of about 465,000, and could be extended to outlying districts when required.

The "N.E. 9th Street" main pumping station would receive the sewage from the northeast section of the city along Biscayne Bay. The so-called "N.W. 4th Street" main pumping station would receive all the sewage from south of the Miami River and from part of the area north of the river. These stations would handle, initially, the sewage from tributary populations of 188,000 and 146,000 respectively. The future installation of additional pumping equipment would permit handling the sewage from 353,000 and 180,000 people respectively. These population allowances would permit greater concentrations of population in either of the tributary areas than the average anticipated for the city as a whole in 1980.

Four small stations would be required to lift sewage from low areas into the interceptors. These stations would be located at N.E. 77th Street and N.E. 5th Avenue, at N.E. 55th Terrace and N. Bay Shore Drive, at S.E. 25th Road and Brickell Avenue, and at Brickell Avenue and S.E. 11th Street.

The sewage would be pumped from the two principal pumping stations through independent force mains which would join in Bay Front Park. From the junction of these mains, a single main, 72 in. in diameter, would cross the bay to the sewage treatment plant on Virginia Key (Fig. 2). This main would have a capacity of 153 mgd, the anticipated maximum flow from a tributary population of about 465,000 in the entire city during the winter of 1980.

The proposed sewage treatment plant was designed to embody the latest practice in sanitary engineering based on experience at other plants throughout the country. The plant would treat an average flow of 47 mgd from the sewered population of 340,000 expected in the winter of 1964 or 1965, and the layout is such as to permit expansion. Certain features, such as conduits, were designed to handle up to 153 mgd, the anticipated peak flow in 1980.

At the proposed treatment plant, the sewage would first pass through aerated grit chambers, then through measuring flumes before aeration in large retention tanks. After aeration, the treated sewage would pass through settling tanks before discharge through the ocean outfall. Preliminary settling tanks were omitted in the design because of the weakness of the sewage and the desire to reduce the danger of septicity.

Part of the solids or sludge removed by the settling tanks would be returned to the inlets of the aeration tanks. That part of the sludge not mixed with the incoming sewage would be digested, dewatered, and incinerated. Gas from digestion would provide a substantial part of the power requirements of the process. The effluent would be adequately disinfected by chlorine.

The purified and disinfected effluent would be discharged through a 90-in. outfall with multiple outlets nearly one mile from shore. The quality of the effluent and the rapidity of its mingling with the ocean waters would be such that the recreational use of adjacent shore waters would be adequately protected. The outfall would have a capacity of 153 mgd, equal to the maximum flow anticipated from the 1980 winter population. If necessary in the distant future, this capacity could be increased by installing a low-head booster pumping station.

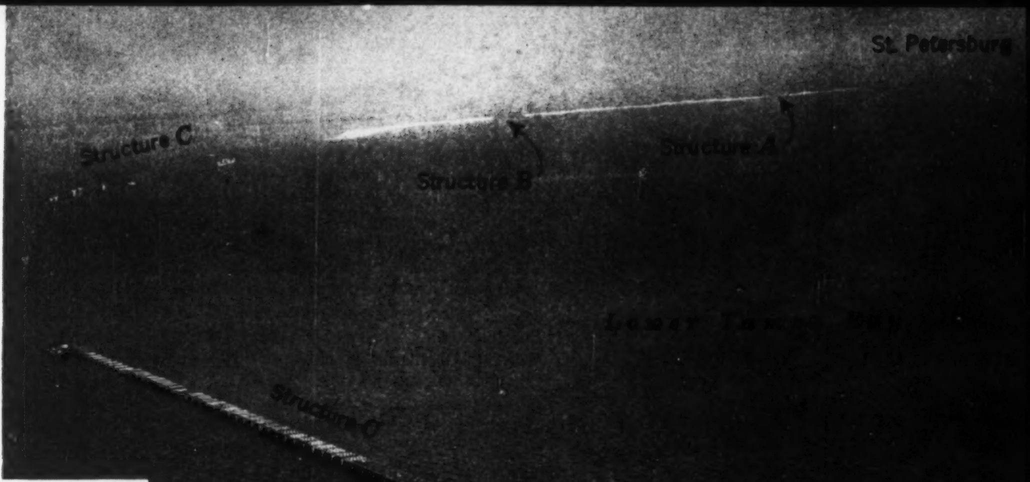
Bids for the construction of the project (Table II) were received on January 15, 1953. Although the engineer's estimates for individual contracts deviated from the low bids, the sum of the estimates for all five contracts exceeded the sum of the low bids by about $110,000.

Following the receipt of these bids, the Water and Sewer Board of Miami made provisional awards to each of the five low bidders, but before these awards could be made final, a taxpayer's suit was filed to enjoin the sale of the bonds required to finance the project. This suit was based on the fact that the financial adviser to the city also headed the syndicate offering to purchase the bonds and that there was no competitive bidding. The city attempted to have the suit dismissed but, on appeal, the Supreme Court of Florida ruled that the particular circumstances connected with the proposed sale made it "contrary to public policy and therefore void."

Subsequent to this ruling, the city advertised for bids for the sale of the bonds, these bids to be received May 27, 1953. In the meantime, the contractors submitting the low bids agreed to hold their bids firm. Another situation which may make for further delay in carrying out the sewerage project arises from proposed legislation which would consolidate the administration of the city of Miami with that of Dade County.

In view of these legal, financial, and political developments, it is impossible at this writing (June 1953) to predict just when construction on the pollution abatement program will start. Truly, "there are more things in heaven and earth" that can affect an engineering project than are taught in engineering schools.

(This article is taken from Mr. Chase's paper read before the Sanitary Engineering Division, with Ralph E. Fuhrman, member of the Division's Executive Committee presiding, at the ASCE Miami Beach Convention.)


St. Petersburg
Structure C
Structure B
Structure A
Lower Tampa Bay
Structure C

An idea of the expanse of water covered by the survey can be obtained from aerial view showing parts of Structure C in initial stages of construction, with approach embankments on north and south.

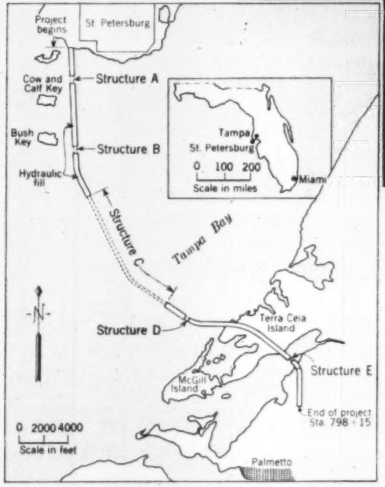

Project begins
St. Petersburg
Cow and Calf Key
Structure A
Bush Key
Structure B
Hydraulic fill
Structure C
Tampa Bay
Tampa
St. Petersburg
0 100 200
Scale in miles
Miami
N
Structure D
Terra Ceia Island
McGill Island
Structure E
End of project Sta. 798+15
0 2000 4000
Scale in feet
Palmetto

FIG. 1. Providing horizontal control for construction of Tampa Bay Bridge meant carrying line across 11 miles of open water. Most difficult section was control for 4½-mile-long Structure C.

First-order survey pin-points construction across Tampa Bay

PETER A. HAKMAN, A.M. ASCE

Resident Engineer, Parsons, Brinckerhoff, Hall & Macdonald, New York, N.Y.

Top flight instruments and a well planned triangulation net enabled the builders of the Lower Tampa Bay Bridge to exceed first-order accuracy in the location of the piers. The toughest section of the 15-mile project (Fig. 1) was the 11-mile Tampa Bay crossing, where winds, heat, and hostile fauna teamed up to bedevil the engineers.

The Lower Tampa Bay Crossing (see article by Maurice N. Quade, in CIVIL ENGINEERING, April 1952) will ultimately connect the city of St. Petersburg with U.S. Highway 541 at a point a few miles north of the cities of Palmetto and Bradenton, Fla. From Maximo Point at the northern extremity, the work will extend south and east, crossing the open water of Tampa Bay to reach the shores of Terra Ceia Island, thence a 2-mile crossing of the island through mangrove swamps and lowlands, followed by a half-mile crossing of Terra Ceia Bay and finally about 1½ miles of roadway to the present main highway (Fig. 1). The part presenting the real control problem is the 11-mile crossing of Tampa Bay which consists of five sections of hydraulically placed embankment and four bridge structures. The central bridge, Structure C, is made up of 5,856 ft of trestle construction on the north, 5,621 ft of high-level bridge over the main ship channel, and 10,896 ft of trestle construction on the south—a total of about 4½ miles of bridge.

One of the first steps of course was the development of a survey control system to serve for the preliminary work, that is, for the preliminary alignment and location of borings and index piles. It was then necessary to devise a system suitable for use throughout the construction stages. For the first phase, an accuracy sufficient to locate a drill rig within a few feet sufficed. For the construction phase, however, piers had to be located to accuracies better than those provided by first-order triangulation. Even a few feet is a comparatively small target out on 11 miles of open and seldom calm water and, since the preliminary work had to be completed in a relatively short time, this phase of the work in itself was a challenge.

In addition to the usual alignment data needed for design purposes, 75 borings and 58 index piles of various types were planned. Within the limited time available, it was evident that a measured base line could not be attempted for this preliminary work even to form the basis of a simple triangulation network for the horizontal control. A system was adopted utilizing three existing aids to ship navigation—the towers known as Mullet Key Shoal Light and Front and Rear Range Mullet Key Lights—which previously had been

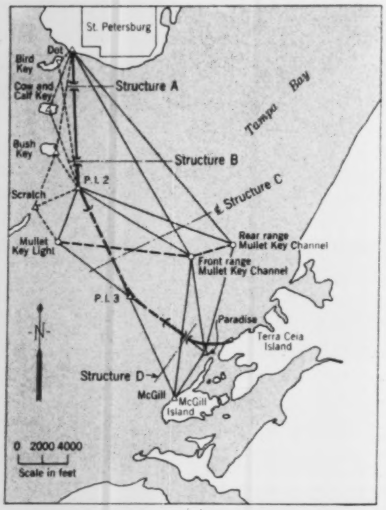
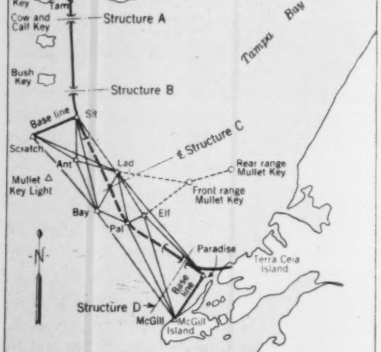


FIG. 2. Preliminary triangulation system was established from three existing aids to navigation, Mullet Key Light, Front Range and Rear Range, Mullet Key channel. These points had been previously triangulated by Corps of Engineers to third-order accuracy and proved satisfactory for preliminary alignment and location of borings and index piles.

FIG. 3. Final triangulation system for construction surveys established base lines as shown and control points at strategic positions such as P.I.'s and other points so located as to give strong intersections. Sight distances were limited to about 4,000 ft. Using a Wild T-3 reading directly to tenths of a second, angle measurement proceeded rapidly and average closure of angles before adjustment was 0.28 sec.



triangulated to by the Corps of Engineers and coordinated to about third-order accuracy (Fig. 2). Other stations were available, some coordinated by the U.S. Coast & Geodetic Survey, but since the precision of most of this work was third order, it soon became apparent that to include too many stations would unnecessarily complicate the immediate problem and probably not lead to any greater accuracy. Hence the three points were adhered to, leading to two base lines of known distance about which a simple triangulation system was evolved.

Angle observations were made with a Wild T-2 direction type of theodolite reading directly to 1 sec and to 0.1 sec by estimation. Time did not permit the erection of elaborate towers over triangulation points for these observations. However, the system was closed and used for location, with practically all the observing done during daylight hours and with a reasonable accuracy—about third order. In general the system proved adequate for our needs. It must be admitted, however, that there were days when the location of a boring or pile driving rig by means of triangulation points as much as 8 miles distant, on a Tampa Bay that is noted for its roughness and under a Florida sun famous for its brightness, appeared to be an impossible task.

Piers Located to 0.02 Ft

The horizontal control system for final construction had to be capable of locating such positions as center lines of piers to within say 0.02 ft. The main problems were found in the more than 8 miles of water crossing between Mullet Key and its shoals to the north and Terra Ceia Island to the south. Structure C is in this section and, being about $4^1/_2$ miles in length, requires the real refinement. Control work for Structures A, B, D and E was less difficult and will not be discussed in detail. Structures A and B, about 1,500 and 1,700 ft long respectively, were treated as small independent systems and presented no major problems.

It appeared then that the most logical and strongest triangulation network for the main crossing would be to locate two base lines, one from the tip of Mullet or Scratch Key, along a shoal to the northeast where water depths average 2 to 3 ft; and the other to be terminated by Paradise and McGill Islands, along which line the water is relatively shoal except for about 2,000 ft ranging from 6 to 12 ft in depth (Fig. 3). Between these two base lines, a network of control points in strategic positions was established, some at points of intersection of tangents and others adjacent to the bridge center-line, so located as to give strong intersections for pier spotting. These points were also so located as to limit the sight distances to piers to about 4,000 ft.

Local Conditions Complicate Survey

Lower Tampa Bay at the site of the crossing presents about 11 miles of clear water, unobstructed and often treacherous. Much of this is shoal, particularly the section north of Scratch Key, where depths are frequently 3 to 6 ft. The deepest water—about 32 ft—occurs in the main ship channel, spanned by Structure C. Adjacent shoreline areas are generally dense, humid, rattlesnake-infested, and insect-ridden mangrove swamps. The local weather is semitropical, with extended periods during the summer of intense sunshine with temperatures consistently in the nineties and relatively light winds or glassy calm. From about July through November, the stormy season reigns, gradually increasing in intensity from occasional sudden rain squalls to several violent squalls daily. There is also the serious threat of hurricanes during this season—hurricanes which are not supposed to strike this area but come so close that the difference is somewhat academic. Winter of course brings cooler weather, generally with stronger winds that hold steady for long periods. The rough waters of Tampa Bay made it difficult to maintain reliable survey control points, requiring, as they did, a sea-going variety of engineer as against the dry-land type. The long distances over water created problems in the transportation of, and communication between, survey parties not ordinarily present in survey work.

The first requirement of the control system as set up on paper was construction of the towers. These had to be substantial in order to withstand heavy wave action; to stand about 20 ft above the water in order to raise the lines of sight above excessive heat radiation; and to provide separate towers for supporting the instrument and its observers. Five of the towers are in water and three on land—all constructed during the preliminary stages of the project by the same contractor who drove the index piles. This permitted installation at moderate cost, before the main construction contracts were awarded.

The towers in the water consist of a

center section supported on three pipe columns, triangular in plan and prefabricated on shore with cross bracing. This section was placed in position on the bay bottom and spudded in place by H-piles driven within the pipes. The pipes were then filled with gravel. This center steel tower supports an instrument trivet stand and sighting target. Surrounding the steel tower and protecting it against displacement due to collision with boats is a second tower, also triangular in plan, constructed on three clusters of timber piles braced together, and forming a deck area on which the engineers operating the theodolite can stand.

These survey towers have thus far proved very satisfactory. Our one concern about them is their ability to withstand severe storm or hurricane conditions. To date they have been exposed only to more or less moderate storms and all but one have remained undisturbed. This one tower, "Lad," has apparently moved about 0.06 ft. Of course the only possible way to ascertain any such permanent movement in these towers, particularly those in about 30 ft of water, is to reobserve all the angles in the network and compare them with the original and adjusted observations. This is somewhat like pulling oneself up by one's own bootstraps. However, it has proved effective and we are confident that any movements of even 0.02 or 0.03 ft can be detected.

About the most disturbing experience so far with these towers has been the flexibility of the outer timber structures. At times during rough weather the timber platforms supporting the men moved so much relative to the stationary center structure as to cause serious seasickness. The most effective solution for this was to provide seasick pills for the survey parties.

Base Line Measured in Sections

The two measured base lines presented a major problem since practically their entire lengths are over water. The sites chosen were actually about the only possible locations. The south base line could perhaps have been run on land but it would have meant hacking through jungle growth and mangrove swamp. The base lines as finally established were about 7,500 and 9,000 ft in length.

The general procedure adopted was to measure each base line in sections of about 2,000 ft, measuring and remeasuring each section until the necessary accuracy was obtained before proceeding to the next section. At the end of each section, a permanent monument was established that could be relied on for several months at least. This was quite a task, especially on certain sections of the south base line where the water is 12 ft deep. In the absence of heavy equipment, a large pipe A-frame with a drop hammer was improvised to drive 4-in.-dia pipe into the bay bottom. At times, in sandy bottom, such pipe markers were stiffened with a concrete block poured in tremie fashion around the pipe and below bay bottom.

With these permanent monuments established at the end of each section, intermediate points were marked by $2^1/_2$-in. pipes driven at 150-ft intervals to facilitate the measuring. These pipes were used to support the tape and hold a point for a few minutes, and hence permanent rigidity was not important.

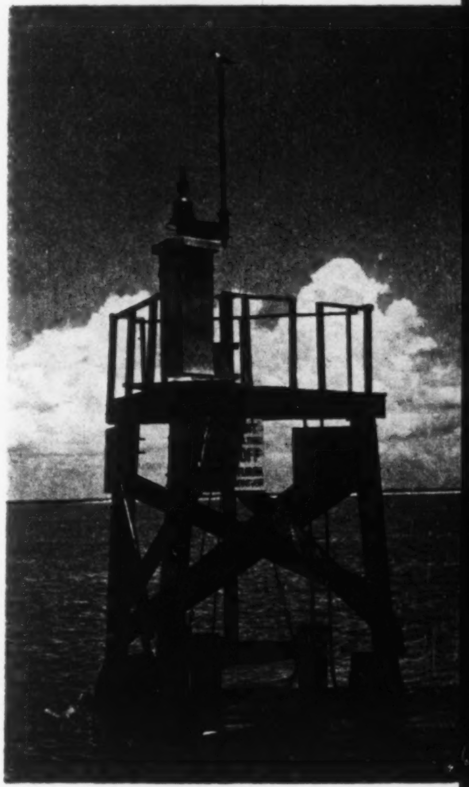
Measurements were taken with a 150-ft Lovar steel tape using a suitable tension scale and thermometer. The tension applied was either 25 or 30 lb. The survey crew worked constantly in shallow water or from skiffs when water depth exceeded shoulder depth. Included among the sidewalk superintendents closely following this part of the work were sharks, sting-rays and sea-going rattlesnakes.

The fact that equipment was always wet with salt water presented a corrosion problem and also required frequent check calibrations of the tape and tension scale. One point that may cause some wonder is that the 150-ft tape was supported only at the ends, thus becoming a long single catenary and presenting considerable resistance to the wind. This drawback was realized but it was thought to be the lesser of two evils. Considerable time and energy were required to set pipe markers whereas the actual time for measurement with ideal weather was small. It was therefore decided to dispense with 50-ft intermediate supports for the tape, get an entire section of base line ready, and then quickly measure it during ideal calm weather.

With this general approach, it was possible to measure the two base lines to a satisfactory degree of accuracy. Most sections were measured from 10 to 20 times to arrive at an acceptable mean value. The most probable error for the north base line was about 1:625,000. For the south base line the accuracy was much higher, 1:1,290,000. Another measure of accuracy, as determined by comparing the measured length of one base line with its calculated length, the calculated length figured from the measured length of the second base line after being carried through the entire unadjusted triangulation net, was about 1:600,000. The accuracy of the angle observations was greater than that of these base lines. However, under the difficult conditions of measurement, the precision obtained for the base lines was thought to be the best that could be expected.

It was anticipated that angle observations from the control towers

(*Continued on page 97*)



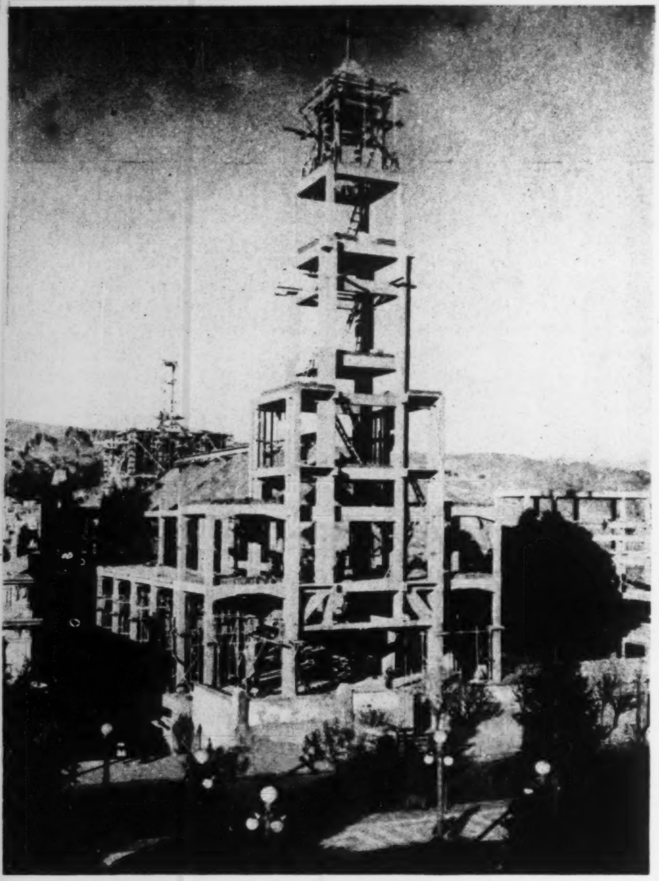
Survey tower is erected in two independent sections. Central steel-pipe H-pile section supports trivet on which instrument rests. Timber pile clusters support timber deck on which surveyors stand. Pills for seasickness were a standard item of surveying gear on this part of job.

Reinforced concrete

GABRIEL E. LUND, M. ASCE

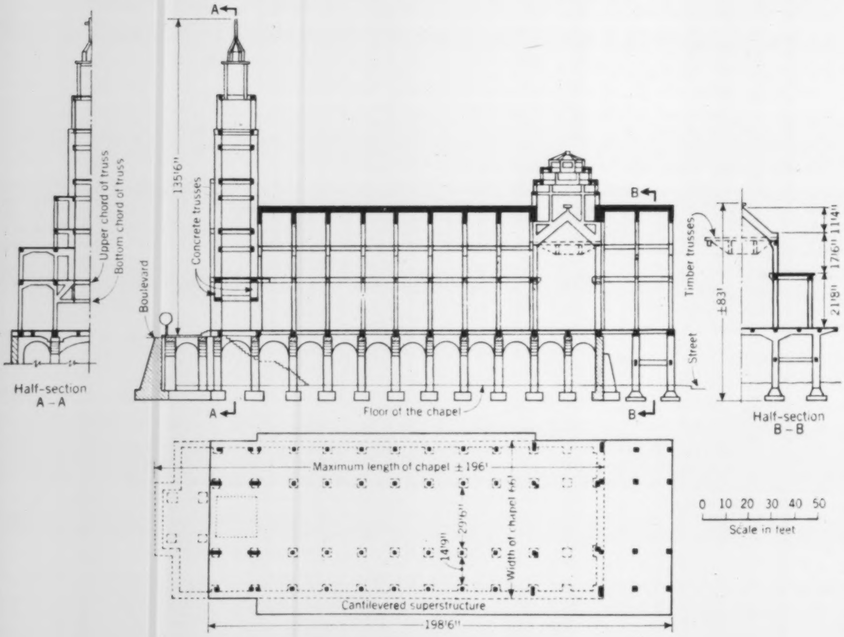
ROBERT D. SCHACHERL, A.M. ASCE

Cochabamba, Bolivia



Widening of Prado Boulevard required that church be built 20 ft further back than originally contemplated, placing steeple over existing masonry columns spaced 29 ft 6 in. on centers. Steeple is carried on two reinforced-concrete trusses spanning vestibule 12 ft above floor level.

FIG. 1. Church rests directly on chapel foundation with exception of last panel and a half (half-section B-B). In pseudo-dome, timber trusses used as falsework supports are indicated by dashed lines. Half-section A-A through steeple shows columns supported on reinforced-concrete trusses. Floor plan shows chapel walls and columns in dashed lines, including four columns at vestibule end originally intended to support steeple. Location of steeple as actually built is shown by dotted square.



In the world's highest capital, La Paz, Bolivia, 12,000 ft above sea level, the American traveler may be surprised to find modern buildings of impressive structural design. Curiously situated in a valley of the Andes which, seen from above, has the aspect of a vast crater, the city also retains many of the picturesque qualities of the old Spanish cities of the colonial period.

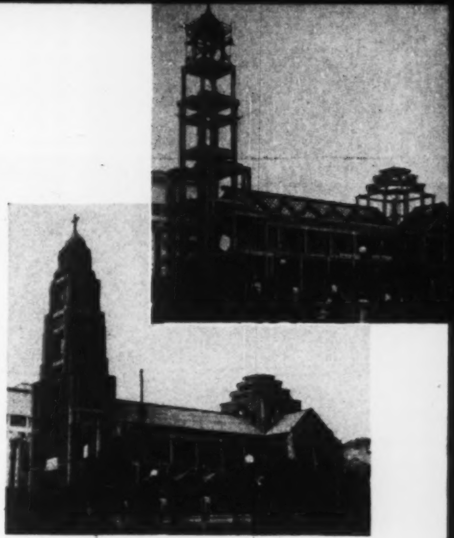
One of the most impressive of the modern structures is the Church of Maria Auxiliadora. For an understanding of the foundation problem faced by the builders of this church, it is necessary to go back to 1925, when the initial construction on the site was undertaken. This was a chapel built one story below the level of the Prado Boulevard because of the sloping ground surface, which drops 24 ft below the boulevard to the grounds of the Don Bosco High School, on which the church is situated. Both school and church are conducted by friars of the Salesian Order.

When the chapel was built, it was planned that the church would be constructed on top of it, with a 16 × 16-ft steeple at the street end. To provide for the support of the steeple, four columns were built in a square at the street end of the chapel. The rest of the columns in the chapel were spaced 29 ft 6 in. on centers, as shown in Fig. 1.

Subsequent widening of the Prado Boulevard made it necessary to set the church location back 20 ft, thus requiring the steeple to be supported on the regular chapel columns instead of on the four columns originally planned for that purpose. This was necessary because the friars were desirous of maintaining the interior arrangements of the chapel, or crypt, unchanged. To carry the last panel of the church, which projected about 30 ft beyond the chapel at the back, 8 new columns were constructed, also shown in Fig. 1.

Early in 1949, the contract for the design and construction of the church was awarded to Vittorio Aloisio,

featured in Bolivian church



Church of Maria Auxiliadora, La Paz, Bolivia, is seen in two stages of construction. Upper photo shows reinforced-concrete skeletal construction, before placing of light-weight tile walls and roof, shown completed in lower photo. Architectural design is based on celebrated Inca temple.

civil engineer and architect, and owner of the contracting firm, Empresa de Construcciones V. Aloisio. The friars specified the approximate dimensions of the church; its location on top of the chapel; and the general style of architecture to be followed—which is taken from Tiahuanaco, a celebrated temple built by the Incas at Lake Titicaca.

From an investigation of the chapel columns it was concluded that the total load on any one column should not exceed about 200 tons, which made it necessary for the superstructure to be either of light-weight steel or of reinforced concrete. Because of the high cost of structural steel in Bolivia, its use was out of the question and reinforced concrete was chosen. By using concrete with ultimate strengths of 2,000, 3,000 and 4,500 psi, according to the design stresses, it was possible to hold the cross section, and therefore the weight, of the members to a minimum.

Truss Construction for Steeple

The design of the steeple, the main structural problem, consists of four columns resting on two reinforced-concrete trusses, with a span of 29 ft 6 in., as shown in Fig. 1 and in photographs. Each truss has a shallow bottom chord which is reinforced with twenty 1-in. round reinforcing bars. The trusses which span the entrance to the church rest on 16 × 48-in. concrete columns extended upward about 12 ft from two pairs of the original masonry columns in the chapel structure.

A pseudo-dome with a repetition of abruptly reentrant levels was adopted instead of a continuous shell cupola, to conform to the architectural style. The reentrant columns are supported by cross beams at their respective levels. The four superstructure columns carrying the pseudo-dome consist of two 16 × 16-in. columns overlapping in a 6 × 6-in. square. All other columns are also 16 × 16 in.

The steel ratio of the longitudinal column reinforcement varies between 1 and 2 percent, the higher ratio being used in sections subject to the greatest bending moments. All longitudinal column reinforcement consists of $^{7}/_{8}$-in. round bars, tied laterally by $^{5}/_{16}$-in. hoops spaced on 10-in. centers.

To keep down the weight of the building, hollow tiles of burned clay were used for all walls and for all ornaments attached to the reinforced-concrete structure. Brackets formed by short concrete cantilevers were provided at columns to support the tile ornaments.

The central nave is covered with a light-weight roof of fiber-cement tile supported on timber purlins, which rest on gabled concrete roof beams.

Construction methods employed were the usual ones for reinforced concrete, except for the forms for the gabled beams of the central nave and the pseudo-dome. These were supported by timber trusses of 30-ft span resting on longitudinal tie-beams at the springing line of the gables. This eliminated the necessity for excessively high falsework supports.

All forms and falsework used were of Oregon pine, imported from the United States. For column sheathing and for the sides of beams and girders, 1-in. stock, dressed on both sides, was employed. For beam and girder bottoms, $1^{1}/_{2}$-in. stock was used.

Column forms were made up into panels by nailing boards to 1 × 4-in. cleats. These panels were held together by independent clamps consisting of two 4 × 4-in. cleats with two bolts and four wedges each.

A 6-S Rex mixer of 6-cu ft capacity was used during most of the construction period. The mixing plant was installed in the yard of the high school, whence the concrete was raised by elevator to placing elevation and wheeled to the forms in wheel barrows, or where space allowed, in two-wheeled carts. All concrete was vibrated.

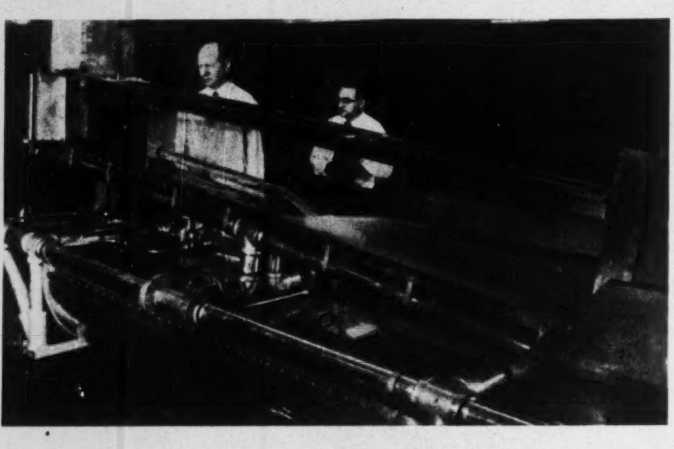
The cement used in this structure came from the only cement factory in Bolivia, that of the Sociedad Boliviana de Cemento, situated in Viacha, a village close to La Paz.

Construction of the reinforced-concrete superstructure was started in early 1949 and finished in the middle of 1950. The hollow burned-clay-tile walls and ornaments were placed during 1951. The stained-glass windows have not yet been installed but the church has been in use for the past year.

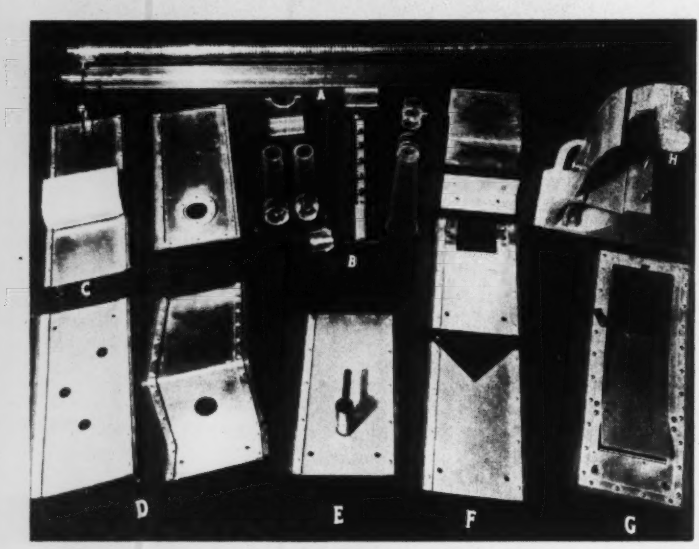
Vittorio Aloisio, owner of the Empresa de Construcciones V. Aloisio, constructor of the Church of Maria Auxiliadora, was responsible for the architectural design and for the substructure work. Robert D. Schacherl, at that time chief engineer for Empresa de Construcçiones V. Aloisio, supervised the structural design and directed the construction of the superstructure. He was assisted by Fernando Saenz and Rene Machicao.

To keep down weight of building, hollow burned-clay tiles were used for all walls and ornaments, and roof was constructed of fiber-cement tiles laid on timber purlins which rest on gabled concrete beams.

Portable used for

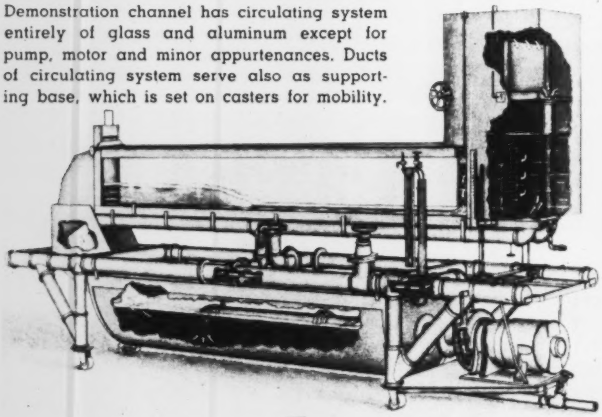


Kodachrome motion picture, "Hydraulics of Culvert Inlets," is being taken to show flow through transparent culvert models placed in the portable demonstration channel of St. Anthony Falls Hydraulic Laboratory.



Typical demonstration models for insertion in portable demonstration channel are: **A**, transparent tubes; **B**, various culvert entrances, exits, and appurtenances; **C**, surface wave maker; **D**, orifices; **E**, short-tube; **F**, various weir types; **G**, two automatic spillway crests; **H**, a bridge pier.

Demonstration channel has circulating system entirely of glass and aluminum except for pump, motor and minor appurtenances. Ducts of circulating system serve also as supporting base, which is set on casters for mobility.



PRINCIPAL DIMENSIONS

Length (overall),	14 ft	Channel width (inside),	6 in.
Height (maximum overall),	7 ft	Channel depth (inside),	15 in.
Width (overall),	3 ft	Flow range,	0 to 0.5 cfs
Channel working length,	10 ft	Slope range,	−7 to +10 percent

Among the many uses of the portable demonstration channel developed at the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota is the making of motion pictures demonstrating hydraulic principles. These pictures have been made available to other research establishments and educational institutions. Typical of them are the Kodachrome films entitled "Flow in Culverts," "Underwater Density Currents," "Some Phenomena of Open Channel Flow," and "Hydraulics of Culvert Inlets." (See Circular No. 3, "List of Publications and Motion Picture Films," St. Anthony Falls Hydraulic Laboratory, University of Minnesota, October 1950.)

This portable demonstration channel was developed more than 15 years ago, but continually serves wider uses in the expanding hydromechanics program of the Laboratory. In addition to its continuous use for lecture-room demonstrations, it has found many applications in exploratory research into diversified hydraulic phenomena.

The flume normally stands in the auditorium of the Laboratory. It is used in conjunction with various special lectures in hydromechanics and has been particularly helpful in a special lecture course in open-channel flow. The unit can be easily moved out of the auditorium into an adjoining equipment room when required to clear the area or make room for other demonstration equipment. For a detailed description of the flume by the writer, see *Portable Demonstration Channel of the St. Anthony Falls Hydraulic Laboratory* (Circular No. 6 of the Laboratory, 1953).

The accompanying perspective drawing shows the channel circulating system, which is constructed entirely of aluminum and glass with the exception of a few minor appurtenances and the pump and motor unit. The latter is a sewage-type centrifugal pump of 300-gpm capacity at 20-ft

demonstration channel

hydraulics motion pictures

LORENZ G. STRAUB, M. ASCE

Director, St. Anthony Falls Hydraulic Laboratory
University of Minnesota, Minneapolis, Minn.

head, directly connected to a 1,725-rpm motor.

The use of aluminum lowers the weight, so that the unit can be easily moved on its casters. It is self-contained except for electric power. Liquids of various density and viscosity characteristics can be used in the circulating system. The discharge and head can be consistently maintained and can be set and controlled at any desired points. Readily adjustable sluice gates and head control baffles are provided at the entrance and exit of the channel.

The headwater reservoir is rigidly fixed to the experimental channel so that there is no change in the entrance characteristics with changes in channel slope. This slope can be adjusted any desired amount while the channel is in operation. The channel walls are transparent from end to end and there is free access to the channel at the top without interference from cross bracing—features which facilitate observation, photography, and the insertion of models of various types.

The apparatus is fabricated of standard aluminum shapes, including the 4-in. pipe for the supporting base, which simultaneously serves as the conduit system for flow ducts. By directing flow through the pivot below the center of the channel, considerable simplification was achieved in maintaining good entrance conditions between the headwater tank and the channel.

Measurement of the rate of flow through the system is variously accomplished by an orifice in the suction line and by calibrated bends in the discharge line. A differential gage connected to the measuring device, and situated at the control valve, facilitates setting and observing the rate of flow. The headwater tank contains an overflow which wastes through the 4-in. aluminum base conduit system. The supply reservoir is made of aluminum sheet metal formed into a half cylinder and suspended from the base frame, which latter serves simultaneously as the flow conduit system.

Many diversified models have been fabricated for use in the channel. These are made mostly of transparent Lucite and aluminum, but wood and other materials have also been found adaptable in many cases. Demonstrations are readily made of orifices, weirs, short-tubes, culverts, dams, spillway tumblebays, hydraulic-jump phenomena, channel constriction, automatic crest gates, hydraulic bore, wave phenomena, Reynolds laminar-turbulent flow critical, localized stream-bed erosion, density currents, and the like.

The equipment was originated by the writer and detailed by John F. Ripken, A.M. ASCE, at the St. Anthony Falls Hydraulic Laboratory. Complete fabrication was by the Laboratory shop personnel. Special models for use in the flume are made in the shop as required.

How would you do it?

> *Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey*

A retired engineer has a cabin at the foot of a mountain with a spring that supplies his cabin with running water. Because the flow of the spring is small, he has a storage tank on the side of the mountain, 30 or 40 ft from his cabin, which gives pressure of 15 to 20 ft.

Midway between the cabin and the storage tank a stone fireplace was built around a heavy-gage copper tank, of some 8 or 10-gal capacity, to provide hot water. About 20 ft of $^1/_2$-in. pipe connects this water heater to the storage tank and a similar pipe conducts the heated water to the cabin.

Obviously, the hydrostatic head of 8 or 10 ft should limit the pressure in the heater tank to that amount, but nevertheless, one day, when there was an unusually hot fire, the tank failed, developing about a 2-in. rupture. What caused the failure? How would you remedy the situation? For solution, see page 96.

EDITOR'S NOTE: This is the sixteenth in a series which started in the February 1952 issue of CIVIL ENGINEERING. In the April 1952 issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it? H.J.G.

The above problem was submitted by G. L. WILLIAMS, M. ASCE, São Paulo, Brazil.

Survey of salaries for civil engineering

In the spring of 1951, the ASCE Committee on Salaries conducted a survey of salaries for civil engineering positions. The resulting report (Civil Engineering, August 1951, pages 37–43) provided data as to starting salaries in the nine grade classifications established by ASCE. Data were supplied on two bases: (1) payroll rates only, and (2) total equivalent compensation after allowance for such tangible perquisites as bonuses, annual leave, sick leave, and employers' contributions to U. S. Social Security.

It has not been considered advisable to carry out a 1953 study in as much detail as that of 1951. However, in view of economic conditions, the Committee decided to develop and present a report with the object of determining the trend in salaries during the past two years.

The Committee is grateful to the Associated General Contractors of America and to the American Association of State Highway Officials for whole-hearted cooperation in assembling data for the survey. As a result, a substantially larger number of returns were received from questionnaires and a broader base was available on which to formulate the results than was the case in 1951.

Data requested for this report dealt only with payroll rates. No regard is paid to any perquisites, nor is there any adjustment to bring reported data into relationship with a standard number of hours per work week. The only adjustment is in the case of those educational institutions where the required terms of service per year are less than the full twelve months. In such cases, reported annual salaries have been adjusted to the twelve-month proportional equivalent of the salary for the shorter period.

As in 1951, the survey was conducted on a sampling basis. A simple questionnaire was sent to representative employers of engineers in the fields of consulting engineering, construction, railroads, industry, public service, and engineering education. To provide a broader base, a larger number of organizations were questioned and a considerably larger number responded than in 1951. The figures presented are based on 339 returns which were usable for some or all of the grades. The respondents include a wide spread in numbers of engineers employed, and the resulting figures are believed to be representative of conditions existing during March, April, and May 1953.

The sources of data supplied herewith are as follows:

	—Data Furnished—	
	No. of Organizations	No. of Engrg Employees
Consulting firms	100	5,407
Construction firms	55	2,438
Railroads	4	652
Public utilities	3	237
Industries	9	3,179
Total private organizations	171	11,913
State highway departments	42	20,996
Other government agencies	12	1,188
Total public organizations	54	22,184
Educational institutions	114	8,825
Grand total	339	42,922

TABLE I. PRIVATE ORGANIZATIONS—*Payroll Rates at Grades Shown*

Data obtained from survey of March, April and May 1953, from 100 consulting firms (5,407 engineers)

ASCE Grade	Orgns Reporting	Entrance Rate, Median	Entrance Rate, Middle 50%	Entrance Rate, Total Range	Orgns Reporting	Max. Rate, Median	Max. Rate, Middle 50%	Max. Rate, Total Range
I	87	$ 3,600	$ 3,120 4,000	$ 2,400 5,000	89	$ 4,300	$ 3,800 4,700	$ 2,912 6,000
II	90	4,160	3,640 4,700	2,800 6,000	88	4,950	4,500 5,700	3,500 7,200
III	94	4,800	4,400 5,100	3,000 7,500	92	5,700	5,200 6,600	4,000 10,000
IV	86	5,520	5,000 6,000	3,640 8,500	80	6,500	5,900 7,488	4,500 12,000
V	76	6,500	5,700 6,900	3,600 10,000	79	7,480	6,800 8,400	4,800 15,000
VI	62	6,900	6,250 7,514	3,900 8,400	61	8,250	7,250 9,100	5,200 11,700
VII	52	8,200	7,200 9,200	4,500 18,000	47	9,500	7,800 10,800	6,000 16,200
VIII	37	9,000	7,800 9,600	5,720 25,000	37	11,440	9,600 14,400	7,250 25,000
IX	33	13,200	10,800 15,000	8,000 50,000	33	20,000	15,000 25,000	11,100 70,000

positions

Report of Committee on Salaries, Spring 1953

Since no educational institutions were included in the 1951 survey, there is, obviously, no basis for indicating a trend in the salaries of teachers. The results of returns from 114 institutions are shown in Table VI. As noted above, salaries reported for teachers whose base-year is less than twelve months have been adjusted upward to show the equivalent amount for a full twelve-month period. It is recognized that the tabulation may be somewhat misleading. However, it is considered that the adjusted results are reasonable figures for annual income, on the assumption that a teacher will be able to augment his income during the vacation time at his disposal at a rate equivalent to his salary during his required teaching period. It is found that 89 percent of all educational institutions reported base salaries on part-time service with periods ranging from nine to eleven months per year.

For convenience of comparison, both the text and tabulations in the remainder of this report are arranged in the same general form as in that of 1951. Much of the text is identical.

Tables I, II, III, IV, V and VI are arranged in the same general form as Tables III and IV of the 1951 report except that the maximum rates as well as the starting rates are shown for each grade. In determining median values, the rates reported by organizations are used as a basis, without regard to the number of engineers in the employ of the organizations.

This report has been prepared from data on civil engineering positions furnished by engineering organizations widely distributed over the continental United States, representative of the principal types of organizations that employ civil engineers, and large enough to have positions that can be allocated to a considerable number of the grade levels in the ASCE classification plan reproduced herewith.

The Committee is of the opinion that some of the maximum and minimum entrance rates shown in the columns headed "total range" in the tables apply to positions which were not properly classified by the respondents to the questionnaire. Except for these extreme values, however, a study of the reports indicates that the allocations to grade appear to have been consistently and satisfactorily performed, and the Committee believes that the medians and middle 50 percent ranges are reliable as of the dates shown.

Complete accuracy cannot be claimed in drawing comparisons between the results of the 1951 and 1953 surveys. That would be possible only if returns from the same organizations were used in both instances. As a matter of fact, some who reported in 1951 are not represented currently and, on the other hand, a large number of organizations are included in this survey which did not appear in that of 1951. Nevertheless, there is such consistency in the returns that direct comparisons appear to be warranted.

TABLE II. PRIVATE ORGANIZATIONS—Payroll Rates at Grades Shown

Data obtained from survey of March, April and May 1953, from 55 construction firms (2,438 engineers)

ASCE Grade	Orgns Reporting	Entrance Rate, Median	Entrance Rate, Middle 50%	Entrance Rate, Total Range	Orgns Reporting	Max. Rate, Median	Max. Rate, Middle 50%	Max. Rate, Total Range
I	36	$ 3,750	$ 3,200 4,000	$ 2,700 4,500	36	$ 4,200	$ 3,900 4,800	$ 3,300 5,400
II	40	4,420	4,000 4,900	3,000 6,000	39	5,400	4,800 6,240	3,900 8,000
III	43	5,200	4,600 6,136	3,600 8,100	43	6,500	5,500 7,300	4,400 9,600
IV	32	6,000	5,160 7,000	4,440 9,000	31	7,200	6,600 8,000	4,800 11,280
V	33	6,600	5,980 7,300	4,800 9,420	32	8,000	7,200 9,120	4,800 13,440
VI	28	7,500	6,500 8,500	5,000 11,400	29	9,000	8,000 10,200	5,400 15,240
VII	27	7,500	6,900 9,000	5,400 12,000	25	10,560	9,000 12,000	5,400 18,000
VIII	29	9,600	7,800 11,100	6,370 18,000	26	12,900	10,200 15,000	6,600 20,400
IX	24	13,200	10,400 16,500	8,000 21,600	22	20,000	16,500 28,800	12,000 50,000

By making use of data published in Engineers Joint Council's 1946 survey, entitled *The Engineering Profession in Transition*, Fig. 1 accompanying this report presents the trend in entrance median salaries for men in the lowest grade (ASCE Grade I) of professional engineering from 1939 to date. This indicates that during the seven-year period, from 1939 to 1946, there was a substantially uniform increase at the rate of $177 per year. This was followed by five years showing a lesser rate, which may be explained by the increased supply of engineers due to the influx of GI graduates. For the most recent two years, the trend has been upward at an average of approximately $300 per year in this grade.

For examination of the trend in base salary increases in the various grades, Fig. 2 is presented. For this purpose, a single median figure for each grade, including all reported salaries, was computed. This was done by determining averages in each case, using the medians for public organizations and private organizations and weighting them in accordance with the number of reports on which each is based. Quite naturally, the results are somewhat eccentric because of the relatively few organizations reporting as compared with the whole field of employment. However, it is considered that the several values fall into a pattern sufficiently consistent to warrant the development of the curve shown on the diagram as being typical of the trend.

As would be expected, the greatest ratio of advance is found in Grade I, where an increase of 20 percent, as compared with the entrance rates reported in 1951, is indicated. From that high point, there is a rather regular reduction in percentage as far as Grades VI and VII, for which returns indicate that salaries in 1953 are substantially the same as in 1951. For the two highest grades, the curve turns upward, indicating a median of 5 percent increase for Grade IX.

In evaluating these results, it must be borne in mind that bonuses are an important factor of compensation in the higher grades. In general, bonuses play little part in grades lower than IV or V, while frequently they form a substantial part of overall compensation for the higher grades. It is proper to assume that figures for total compensation for all grades would produce a much flatter curve than that shown. However, the curve as drawn is specific evidence of the generally recognized fact that, while salaries of beginners in the profession have been advancing at a rapid rate, employees in the middle brackets are far from receiving comparable compensation.

As noted, this report carries no 1953 data as to overall rates of compensation, including equivalent value for perquisites. However, it is believed that the relationships between "payroll rates" and "total equivalent compensation" as developed in the 1951 ASCE report may be applied to current base payroll rates without introducing any errors of consequence. As a matter of interest, Table VII is shown as a basis for comparison.

In the 1951 ASCE report, tables were presented making separate showings of data on base payroll salaries and on salaries plus tangible perquisites such as holidays, annual vacations, sick leave, bonus, and employers' contribution to Social Security. Retirement plan contributions, insurance, and similar employee benefits were not included. It was found that the medians of the entrance salaries upset to reflect additional tangible benefits ran from 12 percent to 18 percent more than the payroll rates in private organizations and from 15 percent to 18

TABLE III. PRIVATE ORGANIZATIONS

(Consulting Firms, Construction Firms and Others)

Data obtained from survey of March, April and May 1953, from 171 private organizations (11,913 engineers)

ASCE Grade	Orgns Reporting	Entrance Rate, Median	Entrance Rate, Middle 50%	Entrance Rate, Total Range	Orgns Reporting	Max. Rate, Median	Max. Rate, Middle 50%	Max. Rate, Total Range
I	137	$ 3,750	$ 3,300 4,132	$ 2,400 5,000	139	$ 4,356	$ 3,900 4,800	$ 2,912 6,000
II	144	4,150	3,600 4,750	2,800 6,000	144	5,100	4,700 5,876	3,500 8,000
III	151	4,940	4,500 5,544	3,000 8,100	150	6,240	5,408 7,200	4,000 10,000
IV	133	5,700	5,100 6,300	3,640 9,000	126	6,900	6,000 8,000	4,500 12,000
V	123	6,600	5,600 7,200	3,600 10,000	125	8,000	7,080 9,120	4,800 15,000
VI	101	7,250	6,500 8,000	3,900 11,400	100	8,400	7,500 10,000	5,200 15,780
VII	92	8,200	7,020 9,500	4,500 18,000	84	10,500	8,700 11,671	5,400 18,000
VIII	65	9,400	7,800 11,000	5,720 25,000	70	12,420	10,200 16,200	6,600 25,000
IX	64	14,000	10,800 17,000	8,000 50,000	55	20,000	15,780 28,800	11,100 70,000 up

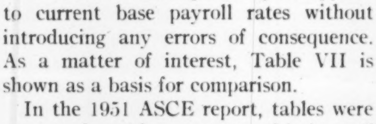


FIG. 1. Trend of annual median base salaries for entrance in ASCE Grade I are plotted for years 1939–1953. Data for 1939, 1943 and 1946, were taken from *The Engineering Profession in Transition;* for 1951 and 1953, from ASCE Salary Surveys.

percent in public organizations. Table VII shows these details by grades.

On the entrance salaries of private organizations these figures indicate that real salaries average about 16 percent over payroll medians. For public organizations, the average is about 17 percent. It is believed that these approximations can be applied safely to the entrance payroll salary medians developed in the current survey.

The tabulated rates should not be considered as absolute. Neither are they recommendations. The results of the survey are published as information and for guidance in the study of compensation for civil engineering positions. If more precise data on prevailing rates are desired, they can be obtained by performing a salary survey in a particular region or area. ASCE Manual No. 30, entitled *Job Evaluation and Salary Surveys*, published in 1952, describes a sound method of conducting and evaluating such surveys.

ASCE Classification of Civil Engineering Positions

When it is desired to ascertain the relative levels of professional civil engineering positions, they should be classified according to the relative importance of duties to be performed and responsibilities incident thereto. In this report, as in that of 1951, a general specification has been established for each classification. These specifications describe the duties and requirements usually associated with the classifications and the qualifications expected of the persons who perform the work and discharge the specified responsibilities.

These nine ASCE grade specifications, adopted in 1946, are based, grade for grade, on statements published by the U. S. Civil Service Commission regarding its professional grades formerly identified as "P-1" through "P-9," and since October 1949 identified (without other change) as "GS-5, 7, 9, 11, 12, 13, 14, 15, and 16." In each case the new "GS" number or grade designation is shown following the comparable ASCE grade description.

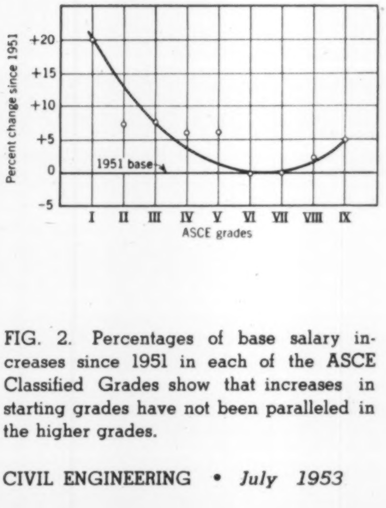


FIG. 2. Percentages of base salary increases since 1951 in each of the ASCE Classified Grades show that increases in starting grades have not been paralleled in the higher grades.

It is expected that in applying this plan to organizations which do not have employees in all the nine classifications, due consideration will be given to the appropriate relationship of the various positions which exist in such organizations, and the duties and responsibilities of such positions.

Also, in large organizations where engineering training is considered desirable for the managerial staff, men with engineering training and experience will occupy positions which are not primarily engineering in character. These positions many times will carry salaries that are compensation in part for managerial functions. These positions should not be assigned to engineering grades. The responsible engineering head of a large organization will in general be considered to be in Grade IX.

ASCE Grade Specifications

These classifications include all classes of positions, the duties of which are to perform operational, creative, advisory, administrative, or research work which is based on the established principles of the civil engineering profession. The fundamental prerequisite for every position to be classified in these grades is professional, scientific, or technical training equivalent to that represented by graduation from a college or university of recognized standing.

TABLE IV. PUBLIC ORGANIZATIONS—Payroll Rates at Grades Shown

Data obtained from survey of March, April and May 1953,
42 state highway departments (20,996 engineers)

ASCE Grade	Orgns Reporting	Entrance Rate, Median	Entrance Rate, Middle 50%	Entrance Rate, Total Range	Orgns Reporting	Max. Rate, Median	Max. Rate, Middle 50%	Max. Rate, Total Range
I	41	$3,180	$ 2,640 3,660	$ 1,920 4,296	41	$ 4,020	$ 3,360 4,440	$ 2,400 5,560
II	38	3,744	3,120 4,080	2,400 4,740	39	4,680	3,840 5,100	2,970 6,300
III	38	4,428	3,660 4,964	2,970 5,880	38	5,328	4,575 6,180	3,330 7,008
IV	42	4,976	4,230 5,460	3,330 7,008	42	5,820	5,160 6,900	4,500 8,520
V	40	5,700	5,040 6,156	3,900 7,754	40	6,720	6,144 7,592	4,860 9,420
VI	40	6,180	5,700 7,000	3,900 10,200	40	7,500	6,354 8,500	4,860 13,440
VII	36	7,200	6,300 8,400	4,620 11,925	40	8,604	7,020 9,648	5,700 13,440
VIII	29	8,500	7,344 9,180	5,496 11,400	31	10,020	7,800 10,800	6,000 16,900
IX	28	8,500	7,600 10,000	5,500 13,800	32	9,780	8,760 12,000	6,500 19,500

Grade I

Grade I includes all positions which involve, under immediate supervision, the performance of fundamental civil engineering duties requiring professional training but little or no experience. (Federal GS-5)

Grade II

Grade II includes all positions which involve, under immediate or general supervision, individually or with a small number of subordinates, the performance of civil engineering duties requiring professional training, previous experience, and to a limited extent the exercise of independent judgment. (Federal GS-7)

Grade III

Grade III includes all positions which involve, under general supervision, individually or with a number of subordinates, the performance of civil engineering duties of substantial difficulty and responsibility, requiring professional training, previous experience, and independent judgment. (Federal GS-9)

Grade IV

Grade IV includes all positions which involve, under general supervision, individually or with a number of subordinates, the performance of difficult civil engineering duties or the supervision of a subdivision of an engineering organization, requiring professional training, previous experience, recognized leadership, and independent judgment. (Federal GS-11)

Grade V

Grade V includes all positions which involve, under general supervision, individually or with a number of subordinates, the performance of difficult civil engineering duties or the supervision of a division of an engineering organization, or the direction of a staff on investigative studies, research and testing, design, or construction, requiring professional training, previous experience, recognized leadership, and independent judgment. (Federal GS-12)

TABLE V. PUBLIC ORGANIZATIONS (Including State Highway Departments)

Data obtained from survey of March, April and May 1953, from 54 public organizations (22,184 engineers)

ASCE Grade	Orgns Reporting	Entrance Rate, Median	Entrance Rate, Middle 50%	Entrance Rate, Total Range	Orgns Reporting	Max. Rate, Median	Max. Rate, Middle 50%	Max. Rate, Total Range
I	50	$3,411	$ 2,760 3,768	$ 1,920 4,296	50	$ 4,080	$ 3,540 4,472	$ 2,400 5,560
II	49	3,900	3,210 4,264	2,400 5,020	50	4,704	4,080 5,112	2,970 6,300
III	49	4,560	3,888 5,060	2,970 5,880	49	5,412	4,860 6,096	3,330 7,008
IV	54	4,980	4,296 5,760	3,330 7,008	54	6,096	5,475 6,940	4,500 8,520
V	53	5,760	5,136 6,373	3,900 7,976	52	7,000	6,300 7,632	4,860 9,656
VI	51	6,240	5,700 7,200	3,900 10,200	51	7,800	6,360 8,944	4,860 13,440
VII	46	7,620	6,354 8,760	4,620 11,925	50	9,000	7,200 10,212	5,700 13,440
VIII	36	8,676	7,500 9,600	5,496 12,600	38	10,200	8,700 11,004	6,000 16,900
IX	33	9,600	7,600 11,280	5,500 17,400	37	10,608	8,940 12,600	6,500 19,500

Grade VI

Grade VI includes all positions which involve, under general direction, individually or with a number of subordinates, the performance of difficult civil engineering duties or the supervision of a division of an engineering organization, or acting as the principal assistant to the head of a division of a large engineering organization or the direction of a staff on investigative studies, design or construction requiring professional training, successful experience in engineering work. (Federal GS-13)

Grade VII

Grade VII includes all positions which involve, under general direction, individually or with a number of subordinates, the performance of important civil engineering duties or the supervision of a division of a large engineering organization, or the direction of a staff on investigative studies, design or construction, requiring professional training, extensive successful experience in engineering work with demonstrated aptitude and capacity for increased responsibilities in managerial and executive functions. (Federal GS-14)

Grade VIII

Grade VIII includes all positions, such as:

(*a*) the assistant to the technical and administrative head of an important engineering organization; or

(*b*) the technical and administrative head of a lesser engineering organization; or

(*c*) positions involving the development, analysis, and evaluation, for final executive action, of difficult and complex engineering projects with respect to their feasibility, cost, economic justification, and public necessity or convenience. (Federal GS-15)

Grade IX

Grade IX includes all positions, such as:

(*a*) the administrative and professional head of an important engineering organization with full authority and responsibility for conceiving and executing all the plans and functions of the organization, directing an administrative and professional engineering staff engaged in varied important projects; or

(*b*) positions requiring highly specialized professional engineering or scientific ability. (Federal GS-16)

In spite of the fact that the 1953 survey did not cover any of the customary "fringe benefits," it is recognized that such added perquisites definitely form a part of the overall compensation received by employees. As an indication of the extent of some of the more important perquisites, the following data from the 1951 report are given in the belief that the various figures shown are substantially the same now as then.

Hours of Work per Week:

Eighty-two percent of private firms and 53 percent of public agencies reported 40 hours as the normal work-week. Range of replies was from 35 to 50 hours. Field staffs frequently work longer hours than office staffs, the added time ranging from four to ten hours per week.

Holidays:

Seventy-four percent of private firms observe 5, 6, or 7 holidays, with 40 percent giving 6. Range is from 5 to 12. Sixty-seven percent of public agencies observe 10, 11, 12, or 13 holidays; 31 percent give 11. The range is from 6 to 15.

Annual Leave or Vacation:

Seventy-eight percent of private firms allow 10 work days for vacation (two calendar weeks). The range is 9 to 18 work days. Thirty percent of public agencies reported 10 work days for vacation; 28 percent reported 12; and 18 percent reported 15. The range is 9 to 26 work days.

Sick Leave:

Fifty percent of the private firms reported that they have no formal allowance for sick leave. Of those that have an allowance, 47 percent favor 10 work days, the range being from 5 to 20. Thirty-nine percent of public agencies allow 12 work days; 22 percent allow 15; and 16 percent allow 10. The range is from 9 to 30 work days.

There is known to be a great variety in the provisions for sick benefit plans, such as when the allowance starts (immediately, or after so many days of illness), scaled allowances according to length of service, etc.

Bonus:

Eighty percent of consulting engineers pay a bonus to their employees, from 2 percent up, the average being between 7 and 8 percent or about four-weeks' salary. The same percentage of construction firms also pay a bonus at about the same average rate as the consultants.

U. S. Social Security:

U. S. Social Security Accounts for their employees are carried universally by private organizations that employ civil engineers except railroads, whose employees are covered by the Railroad Retirement Act. The public agencies that responded included no Social Security Accounts.

Retirement Plans:

Retirement plans for employees, other than U. S. Social Security, were reported by 37 percent of the private, and 86 percent of the public organizations that reported. The contributions reported by employers ranged between 3 percent and $7^1/_2$ percent of salary, 5 percent and 6 percent being the most frequent.

The Committee is gratified by the general interest being shown in the matter of salaries for engineering employees. Engineers Joint Council, acting on behalf of its eight constituent societies, currently is conducting a survey. Of somewhat different scope than that encompassed by this report, it will be directed largely toward conditions in industries throughout the country and should result in a highly valuable addition to currently available information.

This report is in accordance with the desire of the ASCE Board of Direction, as expressed at its meeting in New Orleans, La., March 3 and 4, 1952, to keep abreast of the salary picture in the profession. The next report is scheduled to be made in the spring of 1955.

Respectfully submitted,

Robert J. Ellison
Carroll A. Farwell
Warren W. Parks, *Contact Member*
H. E. McGee, *Vice Chairman*
Ray E. Lawrence, *Chairman*

TABLE VI. EDUCATIONAL INSTITUTIONS—Payroll Rates at Grade Shown*

Data obtained from survey of March, April and May 1953, from 114 educational institutions (8,825 engineers)

Grade	No. Reporting	Entrance Rate, Median	Entrance Rate, Middle 50%	Entrance Rate, Total Range	No. Reporting	Max. Rate, Median	Max. Rate, Middle 50%	Max. Rate, Total Range
Instructor	107	$4,080	$3,733 4,666	$ 2,400 6,400	104	$5,328	$ 4,933 5,766	$ 4,000 8,666
Assist. Prof.	110	5,172	4,672 5,685	3,600 7,333	109	6,280	5,733 7,128	4,800 10,133
Assoc. Prof.	109	6,400	5,484 6,912	4,266 8,800	108	7,480	6,820 8,666	5,345 12,000
Professor	94	7,000	6,400 8,280	4,560 12,000	99	9,000	7,700 11,448	5,620 20,000
Dept. Head	92	7,500	6,666 8,500	5,040 13,704	87	8,952	8,181 10,300	5,970 17,136

* All data reported on basis of less than 12 months of required service have been adjusted upward to the proportional equivalent for a full year.

TABLE VII. Comparison Between Median Base Salaries and Median Total Equivalent Compensation as Reported in ASCE 1951 Survey

	Salaries, Private			Salaries, Public		
		Total Equivalent Compensation			Total Equivalent Compensation	
Grade	Median Base	Increase	% of Base	Median Base	Increase	% of Base
I	$ 3,100	$ 573	118	$3,005	$ 553	118
II	3,921	531	114	3,655	620	117
III	4,690	743	116	4,250	715	117
IV	5,400	975	118	4,910	843	117
V	6,370	930	115	5,590	980	118
VI	7,350	1,215	117	6,470	1,120	117
VII	8,810	1,230	114	7,200	1,292	118
VIII	10,000	1,707	117	7,945	1,192	115
IX	14,300	1,650	112	9,550	1,740	118

Special equipment developed

The Everglades forms a part of the Corps of Engineers project known as the Central and Southern Florida Flood Control Project, which will provide a system of levees, canals, and water-control structures for rapid removal of floodwaters, storage of water for periods of drought, and prevention of overdrainage and salt-water intrusion.

Shortly after Congress authorized the project in June 1948, preliminary investigations were begun. Since then about 700 miles of traverse and vertical control have been established in the Everglades area by the Survey Branch of the Jacksonville District of the Corps. In addition, core holes, auger borings, and probings have been taken on an average of every one-half mile over the traverse lines.

The Everglades of Florida, contrary to the usual conception, is not a dense, impregnable jungle. It is, as the name implies, a glade of vast solitude of sawgrass and water, with an occasional small hammock of trees. It averages some 40 miles wide and extends about 100 miles from Lake Okeechobee to the sea at the southern end of Florida (Fig. 1). The Everglades lies in a trough of sedimentary lime rock and is bordered on the east by a narrow coastal ridge which attains elevations up to 25 ft above mean sea level. The entire area is composed of peaty muck, at present averaging about 17 ft above mean sea level at Lake Okeechobee and only 6 to 7 ft above mean sea level in the latitude of Miami. The depth of the muck varies from 8 to 14 ft at Lake Okeechobee to about 1 ft in the latitude of Miami.

In accomplishing the survey work, many unusual problems were encountered, the majority pertaining to transportation rather than technique. Surveying procedures were those used daily by any surveyor accomplishing work to third-order accuracy. The principal problems were:

- Lack of maps
- No vertical or horizontal control in the immediate area
- Instability of the muck
- Transportation

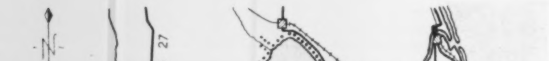


FIG. 1. Survey for Central and Southern Florida Flood Control Project involved five years of hard work in Everglades. Traverse for western control survery was run along Levees 1, 2, 3 and 28. Eastern control net was run along U. S. Highway 27 from Miami to Lake Okeechobee.

The only maps of the Everglades available were those prepared by the Soil Conservation Service in connection with a soils study published in 1946. These planimetric maps, showing in colors the various types of growth and soils, were of great assistance, particularly in delineating the usable soil, which was the basic criteria for determining the alignment of perimeter levees. In some instances U. S. Geological Survey quad maps were available for the outer fringe of the Everglades. Another source of information was original land survey notes, which covered all but a few of the townships in the Glades area. These notes were used extensively for some of the interior levees run on section lines.

Vertical and horizontal control prior to commencement of the work consisted of a first- to third-order Coast and Geodetic control extending down the ridge section of the east coast, across the state from West Palm Beach to Fort Myers, and along the Tamiami Trail from Miami to the west coast, and some scattered stations on the west coast. However, all this control was, on the average, 20 miles from the eastern and 60 miles from the western fringe of the Everglades.

To have an accurate control available in the immediate vicinity of the work, it was necessary to establish a secondary net to third-order accuracy based on the existing Coast and Geodetic control. To provide this control, a line was established along U. S. Highway No. 27, commencing at Miami and extending to Lake Okeechobee, a distance of about 65 miles. For the western net, a line was run along the proposed alignment of Levees 1, 2, 3, and 28, commencing in the vicinity of Clewiston and running south about 80 miles to the Tamiami Trail (Fig. 1). Reference monuments were placed about every mile, and on all monuments vertical control was established. All work was to third-order accuracy with coordinates computed for every monument.

In setting up each camp site, the core-drill machine drilled a well to obtain good drinking water. A small mobile generator supplied electric

for surveying in Florida Everglades

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power, and bottled gas was used for cooking. A portable transmitter and receiver was used to maintain radio communication with our Clewiston office, which could relay messages to Jacksonville over the radio emergency network.

Each day the men left camp shortly after daylight and returned at dusk. All employees were instructed that they should always leave the site of the work in time to return to camp before dark. Occasionally, when a party would return after dark, a large fire would be built to guide them back.

Before running the line a reconnaissance was made by jeep and airboat, and all points of intersection were flagged. This tentative line was then flown, utilizing a small, slow plane flying at an altitude of about 300 ft. From the aerial reconnaissance, adjustments were made to take advantage of the best possible ground conditions. In running the traverse, experiments were made using balloons, smoke from burning old automobile tires, and a flare pistol for siting the forward point of intersection. The flare pistol was found to be the most satisfactory. Exact location of the point of intersection was not necessary, since the entire alignment was tentative and the staking of points of intersection was mainly to determine the most accessible alignment. Average distance of traversing per day was about one-half mile. This low average was due to the distance that had to be traveled to and from camp, as well as to ground conditions.

Muck Impedes Survey

The instability of the muck created more problems than any other single factor. The slightest shifting of weight of any of the surveyors, even without movement of the feet, would cause the instrument bubble to move several graduations. To overcome this difficulty two methods were used. One was the standard procedure of having one man keep the bubble constantly level; the other was to use extra-long tripods, which proved to be the most successful from the standpoint both of accuracy and of cost. The tripods were usually 8 ft long and when set with the maximum spread would allow limited movement immediately around the instrument.

Previous experience with bench marks in the Glades area had shown that it was most difficult to maintain accurate elevations over a period of time because of the settlement of the muck. To overcome this problem a piece of 4-in. boiler tube was driven to rock, the tube filled with concrete, and a standard Corps of Engineers survey disk placed in the concrete. Concrete was poured around the base using a nail keg for a form. On all monuments established in the Glades the boiler tube was left about 3 ft above ground and painted yellow. To date these bench marks have proved generally reliable, although some trouble with settlement of monuments has been experienced.

Leveling was considerably more of a problem than traversing, entirely because of the instability of the muck. In addition to the 8-ft tripods, turning pins were utilized for all turns. These pins were metal rods about 1 in. in diameter and 3 to 4 ft long, driven into the ground until firm. In spite of all precautions, reruns to obtain third-order accuracy were at times as high as 40 to 50 percent.

Special Tractor Developed

It was recognized immediately that some form of special transportation must be devised. Innumerable types of swamp buggies were demonstrated but found unsatisfactory. We were seeking a vehicle that could carry four or five men with full equipment, and capable of pulling the core-drill machines, which weighed about 2,000 lb. Eventually a machine was developed in cooperation with a South Florida farm equipment supply company. The tractors are basically HG Model Oliver Cletrac farm tractors which come out of the factory in various track frame gages up to 60 in. No matter what basic model was used, the track frames were widened to 84 in., the track lengthened about 16 in. to give additional overturning stability, and the engine frame and final drives raised to provide a 36-in. clearance above the ground.

The tractor weighs about 5,500 lb and has a gross track area on each side of 36 × 68 in. This large area was achieved by installing, against the steel track plates, 3 × 4-in. green-pine muck shoes 36 in. long, with the 4-in. side flat. The steel track plates are 10 in. wide and on $5^1/_2$-in. centers. In soft ground the wooden shoes last about six months. The effective bearing pressure is about 160 psf of track surface. These tractors have now been in operation about four years and we believe them to be the most satisfactory piece of equipment available for traversing swampy ground.

Specially designed tractor developed for use in soft muck of Everglades has 3 × 4 × 36-in. timbers added to tracks to reduce bearing pressure of vehicle to 160 psf. Vehicle is modification of HG Model Oliver Cletrac farm tractor.

The units can drag skid-mounted core drills weighing as much as 4,000 lb in second gear. They are very effective for a survey crew, as the side tracks push the sawgrass down and leave a thick mat on which the party can work without being mired knee deep. Behind a tractor, survey parties drag a reinforced M-2 assault boat which carries their equipment and supplies and any personnel not riding in the five seats of the tractor. Tractor speed is about 6 mph maximum when not pulling a load, and averages about 4 mph with a load. The present cost of a tractor is $3,800.

Transportation of the core-drill machines was solved to a great extent when the tractors were obtained. The core-drill machines were chosen with weight as the main factor, and were put on 6 × 8-in. runners with a 2 × 12-in. timber scabbed on the bottom of the skids. The M-2 assault boats were used to carry the necessary drill rods, pumps, core boxes, and miscellaneous equipment. The assault boats were also used as tanks to carry water for the drills where water was not available. Whenever it was necessary to cross the main canals or to drill in the canals, the M-2 assault boats served as portable barges, two or more being bolted together and decked with 2-in. lumber. Obviously the tractors and assault boats were two of our most valuable pieces of equipment.

Surveying in Two Stages

The surveying for the Central and Southern Florida Flood Control Project is being accomplished in two stages, preliminary surveying for design criteria, and surveying for preparation of plans and specifications.

In general, the criteria for preliminary surveying of levees and proposed canals are:

Profile at 500-ft intervals and breaks in grade where encountered
Auger borings through muck and/or probings to rock at 500-ft intervals
Type of growth crossed by the traverse line
Core borings at 1-mile intervals
All land corners encountered to be tied to the traverse line
Horizontal and vertical control to third-order accuracy with reference monuments established about every mile

In establishing the control, the traverse was run along the line where the data were to be obtained, with the reference monuments on an offset of from 100 to 300 ft to preserve them during construction. On long traverses, a polaris shot for azimuth tie was taken about every 6 miles and, in addition, shots on any visible known points whenever and wherever possible. Towers were not used because of the instability of the muck and the difficulty of moving in the necessary materials. On existing canals the criteria were the same except that cross sections were taken about every 2,000 ft and additional sections at the breaks as required instead of a profile.

For construction surveys, additional cross sections, auger borings, core borings, and topography are taken as may be required for adequate preparation of plans and specifications. All survey information is not obtained at one time because definite alignment cannot be determined until after the preliminary surveys.

Normal procedure is to send in a traverse party to run the data line and set the reference monuments. As soon as the traverse has been run several miles, a level party is assigned to run the vertical control. On completion of all control, the remainder of the work is done. Usually one party takes the profile, auger borings, and probings.

To determine the thickness of muck, probing rods were first used but were soon found inaccurate because the nature of the material was often such that it was impossible to determine when all the muck had been penetrated. To accurately determine the depth of muck it was necessary to resort to hand-operated earth augers. Probings were taken only to determine the top of rock.

In connection with our survey work we located 35 automatic water-stage recorders throughout the Everglades in cooperation with the U. S. Geological Survey. Since only approximate location was necessary, we used rough methods of traversing. On some of the gages we used a compass for direction, and for distance we tied a piece of cloth on a tractor cleat and counted the revolutions of the track. In establishing one of these gages we came closer to failure than on any other assignment.

In view of the specially bad ground conditions, it was decided to have the survey party camp on the line, so the party of four was equipped with two assault boats for living quarters, camp equipment, provisions for 4 days, two tractors, and a portable radio. An additional tractor was left at the site of departure and arrangements made for two radio contacts per day. At four o'clock on the second day the party radioed that both tractors were stuck, so the next morning the third tractor was sent in, and got stuck about one-half mile from the camp site. The operator had to practically crawl through mud and water to reach the camp. When we were informed by radio of this situation an airboat was sent in.

Airboats are specially constructed, usually of light plywood or aluminum, with a wide beam, blunt bow and stern, and a motor sitting in the stern on a high frame to drive a small airplane propeller. These boats can travel up to 30 or 40 miles per hour in only inches of water, but are limited in use because they must have a relatively clear path and can carry only three or four persons.

The airboat successfully brought out the party and assisted in completion of the survey. It solved the transportation problem, but to run the level line the men still had to fight their way through mud and water, in which at times they sank waist deep. To overcome this, mud shoes were devised by bolting a pair of canvas shoes through the sole and heel to a piece of plywood, hinged with a leather strap under the instep. This crude shoe helped sustain the men in the mud, although considerable effort and time were required to make any progress.

The three tractors were left in the Glades for several weeks until the water fell, and after about two weeks of hard work, using pry-poles, 2 × 12 timbers for matting, and towing cables up to 500 ft in length, were extracted from the mud. On many other occasions the tractors got stuck temporarily but we were always able to get them out.

In trying to explain in a general way how we solved the problems of surveying in this difficult terrain, I have overlooked the most important factor of all—the excellent spirit of the men who did the work. We have spent 5 years in surveying the Everglades and have found no short cuts. It was accomplished slowly, through the hard work of prying tractors from mud holes, crawling on hands and knees through mire, fighting mosquitoes, and on many occasions through the downright stubbornness and pride of the men, which actuated them to accomplish a task in spite of seemingly insurmountable obstacles.

(This article is taken from the paper by Mr. Hartsfield, presented before the Surveying and Mapping Division at the Miami Beach Convention. The session was presided over by Henry B. Aiken, chairman of the Division's Executive Committee.)

1953 Joint Meeting

Hydraulics Division of ASCE

International Association for Hydraulic Research

September 1–4, 1953, at University of Minnesota, Minneapolis, Minn.

REGISTRATION

Auditorium, Museum of Natural History, University of Minnesota. August 31, 1953, 8:00 a.m. to 5:00 p.m. and every day during the meeting. Advance registration is encouraged and may be accomplished by writing to Prof. Loyal A. Johnson, Secretary, Convention Committee, St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minn.

All papers presented at the convention will be preprinted in the Proceedings which will be available at the convention. A limited number of copies of the Proceedings will be available after the convention at $6.00 per copy.

Registration fee	$4.00
Proceedings	4.50
Total	8.50

TUESDAY MORNING

SEPTEMBER 1

Unless otherwise noted all sessions will be held in the auditorium of the Museum of Natural History, University of Minnesota.

8:00 **Registration, Museum of Natural History**

9:30 **General assembly**

Presiding:

Miles S. Kersten, President, Northwestern Section, ASCE

Welcome to the University

Introductory remarks

Lorenz G. Straub, President IHAR

Francis M. Bell, Chairman, Hydraulics Division, ASCE

Convention Address

11:00 **Business Meeting, IAHR**

Presiding: Lorenz G. Straub, President, IAHR.

TUESDAY AFTERNOON

SEPTEMBER 1

1:30 ***Sediment Transportation—A***

Motion of Discrete Particles Along Bed of Turbulent Stream

A. T. Ippen and R. P. Verma, Massachusetts Institute of Technology, U.S.A.

Studies of the Critical Tractive Force for the Entrainment of Bed Materials

L. J. Tison, l'Universite de Gand, Belgium.

Some Factors Affecting the Stability of Canals Constructed in Coarse Granular Materials

E. W. Lane and E. J. Carlson, Bureau of Reclamation, U.S.A.

Variation in Grain Size Distribution of Bed Load in a River Section

A. Nizery and G. Braudeau, Electricite de France.

3:00 ***Waves—A***

Basic Experimental Wave Research

F. Suquet and A. Wallet, Laboratoire Dauphinois d'Hydraulique Neyrpic, France.

Investigation of the Effect of Resonant Structures on Wave Propagation

J. Valembois, Laboratoire National d'Hydraulique, France.

Table Bay as an Oscillating Basin

B. W. Wilson (formerly of South Africa), A. and M. College of Texas, U.S.A.

Wave Damping Effect of Beaches

John J. Healy, U.S. Navy.

Absorption and Reflection of Solitary Waves by a Barrier of Porous Material

P. L. Romita, Politecnico di Milano, Italy.

Action of Side Weirs and Tilting Gates on Translation Waves in Canals

Giulio de Marchi, Politecnico di Milano, Italy.

Discussion from floor

ICE-BREAKER PARTY

Tuesday, Sept. 1 7:30 p.m.

NICOLLET HOTEL, MINNEAPOLIS, MINN.

WEDNESDAY MORNING

SEPTEMBER 2

9:00 ***Density Currents—A***

Presiding: Francis M. Bell, Chairman, Hydraulics Division, ASCE

The Role of Density Currents in Estuaries

Henry Stommel, Woods Hole Oceanographic Institution, U.S.A.

Density Current Problems in an Estuary

Tokuichi Hamada, Transportation Technical Research Institute, Japan.

Density Currents

J. B. Schijf and J. C. Schönfeld, Rijkswaterstaat, Netherlands.

Density Currents: Experimental Research in a Glass Flume

Laboratoire Dauphinois d'Hydraulique Neyrpic, France.

Discussion from floor

10:30 *Air Entrainment—A*

Presiding: Francis M. Bell

Some Prototype Observations of Air-Entrained Flow

V. Michels and M. Lovely, The State Rivers and Water Supply Commission, Australia.

The Flow in a Flume with a 1:1 Slope

Michele Viparelli, Universita di Napoli, Italy.

Experimental Studies of Air Entrainment in Open Channel Flow

Lorenz G. Straub and Owen P. Lamb, St. Anthony Falls Hydraulic Laboratory, U.S.A.

Entrainment of Air in Flowing Water and Technical Problems Connected with It

V. Jevdjevich and L. Levin, Serbian Academy of Science, Yugoslavia.

Air Entrainment in Steeply Sloping Flumes

G. Halbronn, R. Durand, and G. Cohen de Lara, Laboratoire Dauphinois d'Hydraulique Neyrpic, France.

Head Loss and Air Entrainment by Flowing Water in Steep Chutes

Ante Frankovic, Vodogradbeni Laboratory, Yugoslavia.

Discussion from floor

WEDNESDAY AFTERNOON

SEPTEMBER 2

1:30 *Sediment Transportation—B*

A Basic Bed Sediment Transportation Theory Applied to Design of Unique Method of River Diversion by Dredge Operation

Lorenz G. Straub, St. Anthony Falls Hydraulic Laboratory, U.S.A.

BANQUET

Wednesday, Sept. 2 6:30 p.m.

NICOLLET HOTEL, MINNEAPOLIS, MINN.

Regime Theory Equations Applied to a Tidal River Fstuary

T. Blench, University of Alberta, Canada.

Some Basic Requirements for Protection Against Erosion

C. J. Posey, State University of Iowa, U.S.A.

Basic Relationships of the Transportation of Solids in Pipes

R. Durand, Laboratoire Dauphinois d'Hydraulique Neyrpic, France.

Bed-Load Transportmeter for Fine Sand "Sphinx"

J. B. Vinckers, E. W. Bijker, and J. B. Schijf, Rijkswaterstaat, Netherlands.

Experiments Concerning the Infiltration of Water Through a Rock-Mass

L. Escande, École Nationale Supérieure d'Electrotechnique et d'Hydraulique, France.

Discussion from floor

3:30 *Waves—B*

The Influence of a Vertical Wall on a Beach in Front of It

R. C. H. Russell and Sir Claude Inglis, Department of Scientific and Industrial Research, England.

Beach Erosion and Accretion: Formation of Spits and Tombolos

G. Vincent, Laboratoire Dauphinois d'Hydraulique Heyrpic, France.

Beach Erosion in Japan

Koichi Aki, Tokyo University, Japan.

The Effect of Waves on a Sand Beach

Harold Flinsch, Mississippi State College, U.S.A.

Effect of Distortion on Sea-Hydraulic Models with Movable Bed

Léon Levin and M. Voyinovic, Laboratoire d'Hydraulique d'Avala, Yugoslavia.

THURSDAY AFTERNOON

SEPTEMBER 3

1:30 *Density Currents—B*

Presiding: Joseph B. Tiffany, Member Executive Committee, Hydraulics Division, ASCE

Significant Effects of Density Currents in TVA's Integrated Reservoir and River System

Albert S. Fry, Milo A. Churchill, and Rex A. Elder, Tennessee Valley Authority, U.S.A.

Density Currents in Lake Mead

C. S. Howard, Geological Survey, U.S.A.

Systematic Observations of Density Currents in a Hydroelectric Reservoir

A. Nizery and J. Bonnin, Electricite de France.

Some Observations of Density Currents in the Laboratory and in the Field

G. Bata and B. Knezevich, Serbian Academy of Sciences, Yugoslavia.

3:00 *Air Entrainment—B*

Presiding: Joseph B. Tiffany

An Experimental Study of Water Fall

Masashi Hom-ma, University of Tokyo, Japan.

Air Entrained by Water Flowing Down Vertical Shafts

L. M. Laushey and F. T. Mavis, Carnegie Institute of Technology, U.S.A.

Air Entrainment by Flow in a Vertical Pipe; Application to Secondary Supply Shafts

G. Marquenet, Laboratoire National d'Hydraulique, France.

The Effect of Entrained Air on Cavitation Pitting

A. J. Peterka, Bureau of Reclamation, U.S.A.

Air Entraining Devices and Their Use in Correcting Flow Conditions at Weirs and Canal Falls

Mohammad Abdul Hamid, R. F. T. Farrant, and Mushtaq Ahmad, Irrigation Research, Punjab, Pakistan.

Air Demand in Gated Outlet Works

F. B. Campbell and B. Guyton, Corps of Engineers, U.S. Army.

THURSDAY EVENING

SEPTEMBER 3

8:00 **Open Meeting, Research Committee, Hydraulics Division, ASCE**

INSPECTION TRIP

Thursday, Sept. 3

9:00 a.m. to 11:00 a.m.	Inspection trip—St. Anthony Falls Hydraulic Laboratory

Bus tickets obtained at time of registration.

FRIDAY MORNING

SEPTEMBER 4

8:00 ***Sediment Transportation—C***

Presiding: F. L. Lawton, Member of IAHR

Model Studies of Sediment Control Structures on Diversion Dams

Harold M. Martin and E. J. Carlson, Bureau of Reclamation, U.S.A.

A Generalized Model Study of Scour Around Bridge Piers and Abutments

E. M. Laursen and Arthur Toch, State University of Iowa, U.S.A.

Mechanism of Erosion Below Hydraulic Works

Nazir Ahmad, Irrigation Research Institute, Pakistan.

Experiments on Design and Behavior of Spur Dikes

Mushtaq Ahmad, Irrigation Research Institute, Pakistan.

Scour by Solid and Hollow Jets of Water

R. A. Thomas, D. Doddiah, and M. L. Albertson, Colorado A. and M. College, U.S.A.

10:30 ***Waves—C***

Design of Rock-Fill Breakwaters

P. A. Hedar, Chalmers Tekniska Högskola, Sweden.

Experimental Study of Wave Overtopping on Shore Structures

J. M. Caldwell and T. Saville, Jr., Beach Erosion Board, U.S.A.

The Wellawatte Canal Outlet, Ceylon

T. Mylvaganam and W. E. Paranthala, Irrigation Department, Ceylon.

A Multi-Purpose Wave Generator

Charles B. Coyer, U.S. Navy.

A Continuous Recording Point Gage for the Measurement of Surface Waves

W. D. Baines and I. D. Smith, National Research Council, Canada.

Theoretical and Experimental Studies of the Propagation of Translation Waves in Open Channels

J. Nougaro, École Nationale Supérieure d'Electrotechnique et d'Hydraulique, France.

FRIDAY AFTERNOON

SEPTEMBER 4

1:30 **General Session, IAHR**

Presiding, Lorenz G. Straub, President IAHR.

Post-Convention Inspection Trips

A post-convention inspection trip of the Duluth-Superior Harbor is being planned. This is a unique natural harbor formed at the tip of Lake Superior by the famed Minnesota Point. It is the shipping point for an immense tonnage of iron ore from the Iron Range and of grain from the western plains.

Portions of the Upper Mississippi River Navigation Project including Lock and Dam No. 2 at Hastings, Minn., and work along the river may be inspected by visitors to the convention on an all-day tour following the convention.

Ladies' Program

Social meetings, luncheons, and tours for wives and families of members attending the convention are being arranged. A special effort will be made to make the stay of visitors to the Twin Cities an enjoyable one.

HOUSING ACCOMMODATIONS

Housing accommodations for individual needs are available in a variety of forms as described below. Those desiring to make reservation for these accommodations should write to one of the indicated addresses at an early date.

Pioneer Hall Accommodations

Pioneer Hall on the campus of the University of Minnesota is being made available for the exclusive use of convention visitors. The well equipped and comfortable quarters afford room telephones, reserved parking, and other facilities comparable to a better class hotel with the exception of having no private bath facilities. The room makeups are very flexible and permit adjustment to male, female, single or familied groups.

Pioneer Hall is located within walking distance of the convention headquarters in the Museum of Natural History and is convenient to numerous service facilities. Reservations for these quarters will be made in the order received and to the limit of the available facilities.

The rates are $3.00 for the first night and $2.00 for each night thereafter. This rate applies to each adult regardless of whether single or double rooms are occupied. Children occupying cots are charged at a rate of 75 cents per night. Rooms will be available beginning Sunday night, August 30 and extending through Friday night, September 4.

Reservations for rooms must be made prior to August 15 and with full payment accompanying the reservation. Checks should be made payable to the University of Minnesota and sent together with reservation data to Mr. James P. Schroeder, Director, Pioneer Hall, University of Minnesota, Minneapolis 14, Minnesota, USA.

Motor Court or Motel Accommodations

Family vacation groups desiring to use motel facilities during their stay in Minneapolis may wish to contact the Parkway Motor Court, 4757 Hiawatha Avenue, Minneapolis, or the Snelling Motor Court, 5346 Minnehaha Avenue, Minneapolis. These motels are approved by the American Automobile Association and are approximately 5 miles from the convention headquarters.

Hotel Accommodations

Hotel rooms in downtown Minneapolis are approximately 2 miles from the convention headquarters in the Museum of Natural History and may be reached by convenient public transportation. Space will be available in the Minneapolis hotels as shown below. Hotel rooms should be reserved in the name of the individual before August 15, by writing to the Minneapolis Convention and Visitors Bureau, 1750 Hennepin Avenue, Minneapolis 3, Minn.

Hotel and Location	Number of Rooms	Rates per Day with Bath		
		Single	Double	Twin
Andrews Hennepin at 4th	335	$3.75– 4.75	$5.25– 6.75	$6.50– 8.00
Dyckman 27 South 6th St.	300	5.00– 7.00	7.00– 9.00	7.50–12.50
Curtis 10th St. & 4th Ave.	825	4.50– 5.50	5.50– 6.50	7.00– 8.50
Hastings 32 N. 12th St.	95	3.50– 4.50	5.00– 6.00	7.00– 8.00
Leamington 10th St. & 3rd Ave. S.	355	4.50– 5.50	6.50– 7.50	7.50– 9.50
Nicollet Nicollet & Wash. Aves.	500	5.50–10.00	8.50–13.00	9.00–13.00
Normandy 405 S. 8th St	100	4.75– 6.00	6.50– 9.00	8.00– 9.00
Sheridan 1112 Marquette Ave.	450	4.00– 4.50	5.50– 6.50	7.50– 8.50

THE READERS WRITE

Problem of Limiting Deflections for Bridges Needs Study

TO THE EDITOR: The economically important problem of limiting deflections in bridges seems to be characterized by an apparently hopeless disorder. It is of the utmost importance to structural engineers to reconsider the reasons and principles underlying existing deflection limitations. By means of a questionnaire, I contacted 37 bridge officials in 22 nations around the globe about rational principles known to them, but out of a total of 18 answers from 12 nations, nothing positive emerged.

Some American specifications limit deflections by specifying the ratio of girder depth to span length. This is certainly less rational than limiting the deflection ratio but greater simplicity is won, if nothing else.

The design of many other plate-girder bridges is governed by the ultimate deflection ratio rather than by the ultimate stresses. It is then impossible to employ modern high-strength steels which otherwise might be economical. American specifications at least do not prevent this, and they are more straightforward, expressing directly the fact learned from experience that a plate-girder bridge will serve successfully if it has a certain ratio of depth to span.

A few elementary truths should perhaps be restated to clarify this problem. The *vertical deflections* of a bridge in themselves almost never cause any inconvenience or damage. Flexible suspension bridges often deflect several feet under load. Motorists or bus passengers do not even notice this deflection, and they will not sustain any damage. Neither will a well-designed bridge.

Large distortions almost always mean large *changes in the slope* of the roadway, especially near the supports of the bridge. If these are considered harmful *they* should be limited and not the vertical deflections. But the limitation of the maximum roadway slope to one that can be easily negotiated by modern motor traffic would probably never affect the dimensions of a bridge member.

Actually specifications generally do not limit the vertical deflection but rather the ratio of this deflection to the span length. The deflection ratio may be taken also as a measure of the largest permissible change in slope at the supports of the span. The original intention may have been to limit the change in grade at the supports. Railroad bridges may need to limit this change in grade so that the track will not suffer breaks in the vertical angle to impede traffic.

This motive offers the only rational explanation as to why the deflection ratio was limited, but the motive must have been very evanescent. Otherwise a limitation would have been placed directly on the change in grade at the supports. The break in angle in the track would be almost twice as large where two simply supported spans meet over a bridge pier, and there would be no break in the angle over a continuous support.

Vibrations increase stresses and fatigue in the various parts of a bridge and may also react harmfully on vehicles and thus adversely affect traffic safety. In any case it should be the vibrations themselves, that is, their amplitudes, frequencies, accelerations or energy, which in conjunction with observed inconveniences to traffic, should constitute the basis for more rational specifications, serving also the aim of economy.

It should be possible, by a rational analysis of fundamental principles, to clear up the present disorder in the proper limitation of bridge deflections.

S. O. ASPLUND, M.ASCE
Göteborg, Sweden

Three Monumental Bridges Built in Venezuela

TO THE EDITOR: The article by Mr. Freyssinet in the March 1953 issue should be carefully read and studied not only by every American civil engineer interested or engaged in bridge work—regardless of the material of construction—but also by every student of engineering and architecture. This article contains not only fundamental ideas pertaining to the safety, beauty and highest economy of contemporary bridges but also a deep philosophy of design in general, and sincere and valuable advice from one of the leading and most creative engineers of all time.

Mr. Freyssinet estimated the 1930 cost of his proposed 3,300-ft concrete arch (CIVIL ENGINEERING, February 1932) at \$12 1/2 million, giving a unit cost of \$37.50 per sq ft, less than half the cost of the 3,500-ft George Washington Bridge over the Hudson River in New York. The Golden Gate Bridge in San Francisco, with a main suspension span of 4,200 ft, cost approximately \$70 per sq ft in 1931. If designed in reinforced concrete, it would have cost but \$53.40 per sq ft, according to the writer's estimate.

Actual construction of long-span concrete bridges is limping behind designs for them. The Sandoe span of 866 ft in Sweden, completed in 1942, is still the world's record. One American design should not be overlooked, however, as it demonstrates the early interest of our engineers in long-span concrete bridges. This is the bridge designed in 1908 by William H. Burr, M. ASCE, to span 703 ft over Spuyten Duyvil Creek in New York to commemorate the discoveries of Henry Hudson. Since this bridge never was built, the longest concrete span in the United States is still the George Westinghouse Bridge in Pittsburgh, Pa., built in 1931 with a main span of 418 ft (460 ft between center lines of piers).

Freyssinet's largest concrete spans in the Americas—in Venezuela—with a main span of 498 ft, not only are spectacular but also are beautiful. Beauty is an attribute of fitness. In so far as the dimensions and arrangement of the members of a bridge conform to the stresses they must resist and to the purposes they serve, the bridge will be beautiful. The classic statement of this hypothesis was made by Keats: "Beauty is truth, truth beauty."

J. J. POLIVKA, M.ASCE
Berkeley, Calif. *Consulting Engineer*

Grout Cap Compared with Gunite Blanket

TO THE EDITOR: The article "Gunite Blanket Improves Foundation Grouting for Earth Dams," by James B. Hays, M. ASCE, in the April 1953 issue, gives a method of improving foundation grouting. However, I wonder if a grout cap was considered in lieu of the gunite cover. A grout cap is nothing more than an unreinforced concrete footing about 3 ft wide and 3 to 5 ft deep, placed in a carefully excavated trench in the foundation rock. The grout cap itself acts as a positive cutoff against percolating water in the upper 3 to 5 ft of the foundation and the grouted rock forms a cutoff to the desired depth below the bottom of the cap. The grout cap, together with the adjacent rock, tends to act as a "cover" much as the gunite does. This combination has the additional advantage of being much less vulnerable to lifting than a gunite cover, although some calking may be required in the larger joints.

The width of the grouted zone under the gunite cover might be greater than that under the grout cap at the surface, but the positive cutoff formed by the concrete would ordinarily suffice. By using packer grouting methods, the width of the zone at depth could be made the same in either case. Packer grouting also allows some savings in drilling costs. Unless unusual conditions are encountered, it is generally possible to drill the entire hole in one continuous operation or, at the most, two stages.

The relative costs of the gunite cover and the grout cap would vary according to the type of rock and other factors, but under the conditions usually encountered in earth-dam construction the grout cap should be the cheaper. This is largely because of the extra cost of detailed cleanup required to obtain sufficient bond between the gunite and the rock. Under the hard-rock conditions encountered at Kenney Dam, it is easily conceivable that the gunite cover was cheaper. However, the grout cap has been reasonably constructed in many earth-dam foundations where no cutoff wall was used and has proved effective under a variety of conditions.

FRED H. LIPPOLD, M. ASCE
Engineer, U. S. Bureau
Denver, Colo. *of Reclamation*

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SOCIETY NEWS

Florida Shows Off Its Wonders For Miami Beach Convention

"Come to Miami and cool off," boasted an editorial greeting to the 500 members, wives and students assembling in Miami Beach for the spring Convention of ASCE. Nor was this assurance without reason. For many of the visitors had left temperatures considerably higher than those they found on arrival in Miami Beach. Since the headquarters Casablanca Hotel pool and the Atlantic were immediately available for off moments and the meetings were held in the air-cooled halls of the Casablanca and Martinque, any sighs were those of comfort and content. By desire and habit, the resort city had done well.

Southeast Florida has developed so fabulously and projects under way or in prospect are so spectacular and daring that a continuous stream of "ooh's" and "ah's" was heard from touring groups. Those who had not been in Miami Beach for several years were surprised to observe the solid area of construction developed since the war. The theme of the Convention, in fact, was in large measure concerned with what is being done or contemplated in Florida.

Viewed at Wednesday Welcoming Luncheon, sitting in usual order, are Henry H. Hyman, president of Miami Section; Thomas F. Smith, director of Miami Beach convention and news bureau, representing mayor of Miami Beach; Edmund Friedman, ASCE Vice-President; Albert E. Darlow, director of engineering for Miami, representing the mayor of Miami; President Walter L. Huber; Daniel V. Terrell, ASCE presidential nominee for 1954; and Executive Secretary W. N. Carey. Both cities, Miami and Miami Beach, proclaimed the week of the Convention, Civil Engineers' Week.

Miami Section members instrumental in the success of the Convention include (from left to right) Leroy S. Edwards, co-chairman of publicity; William J. Knox, chairman of finance; Robert Hart, member of general convention committee; C. F. Wertz, general chairman; Henry H. Hyman, president of Section; Earl J. Reeder, chairman of Local Sections' cooperation committee; Herbert J. Morrison, entertainment chairman; and William C. Gorman, chairman of registration.

Members attended from 13 southern states and from Puerto Rico, Cuba and Venezuela. The Board of Direction, of course, brought representatives from all over the country. Board and committee meetings preceded the opening technical session on June 16 and the Convention ran through June 19. Under the general chairmanship of C. F. Wertz, the Miami Section, headed by Henry H. Hyman, fully upheld the high standards of ASCE assemblies.

The social events, and there were many of them, began with a reception by Vice-President Edmund Friedman on the Sunday preceding the Convention. The following evening, the Miami Section was host to the officers, Board and headquarters staff at the Lighthouse, directly on the ocean. Wednesday evening was given over to an aquacade in the Casablanca pool. The lavish Morocco Room was the setting for a dinner and dance Thursday evening. The welcoming luncheon on Wednesday brought the greetings of President Hyman for the Miami Section and of the cities of Miami Beach and Miami. National President Walter L. Huber responded. Vice-President Friedman presided. The following day's membership luncheon was addressed by Richard B. Roberts, Economic Research Director, Florida Power and Light Company, on "Development of South Florida," a subject that revealed the great strides of recent years. A Convention luncheon was held Friday.

A conference of representatives from Local Sections in the South, Southeast, Caribbean, and Central and South America, discussed for two days effective means of expanding ASCE activities at the Local Section level. Technical Division meetings began early in the week and continued to the end of the Convention. Over 90 papers were presented for information and discussion. Preprints of 30 of these papers were available at the Convention; five or six more are in article form in this issue; and others are under further consideration. The technical program was a substantial one.

Planned tours included the Miami International Airport, with the world's largest engine overhaul shop, the newest and largest nose hangar in the world and other features of a terminal which handles 47 percent of all traffic from points outside the continental United States.

Other bus and automobile trips took in the University of Miami main campus; the 40-mgd Miami water treatment plant with an ultimate 100-mgd capacity, now under construction; a pumping station under construction on Route 27; and dikes and control structure northwest of Miami, including sluice-gate and Tainter-gate controls.

Mrs. William C. Gorman and Mrs. Earl J. Reeder, co-chairman, and their committee on ladies' activities opened hospitality quarters in the Casablanca on Monday and immediately set in motion a program that afforded a wide variety of entertainment and sightseeing. A style show in the Roney Plaza, a welcoming luncheon, a boat trip around the lavishly beautiful islands of Biscayne Bay along a 30-mile inland waterway route, visits to the Lowe Gallery of Art, the University of Miami and the Parrot Jungle drew large groups.

The famous shopping thoroughfare, Lincoln Road, was the inevitable goal of virtually all the women at the Convention. The tours of both cities, Miami Beach and Miami, made it evident that even in summer these are busy places. An alert convention bureau has achieved outstanding progress in making Miami Beach a convention city in summer. Virtually a smokeless area, since heavy industry is frowned upon, Miami Beach has an impressively clean look, both as to its numerous white buildings and its unpolluted air. Miami Beach, Miami, and their environs, constituting Greater Miami, afforded from the standpoints of beauty, comfort and convenience, and the luxury of pool and ocean bathing, one of the finest convention settings the ASCE has enjoyed.

Some of the members left by boat and plane the evening of the 19th for a Havana tour that extended through Sunday evening. A number of those at the ASCE Convention also attended, at Gainesville, the annual meeting of the American Society for Engineering Education, which ran from June 22 to 26. It was held at the University of Florida.

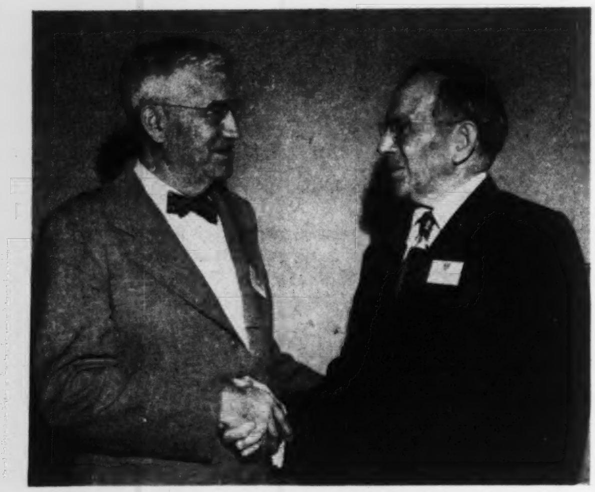
In addition to those previously mentioned, committee chairmen for the Miami Beach Convention included: Herbert J. Morrison, entertainment; George E. Watson, excursions; William J. Knox, finance; William C. Gorman, hotels and registration; Earl J. Reeder, Local Sections' cooperation; Leroy S. Edwards and William Sussman, publicity; Timothy J. Clarke, reception; Murray I. Mantell, student activities; and Col. Lynn Perry, technical program.

Several past and present members of the Board of Direction gathered at the Lighthouse included (standing from left to right) Director Kirby Smith, Vice-President Edmund Friedman, President Huber, Past-Presidents Carlton S. Proctor and Richard E. Dougherty, Vice-Presidents A M Rawn and George W. Burpee, and Director Glenn W. Holcomb.

Shown enjoying themselves at the Miami Section dinner for the Board of Direction, Society officers, and headquarters staff, at the Lighthouse Restaurant, are (left to right) Mr. and Mrs. Gail A. Hathaway, Mr. and Mrs. W. N. Carey, and Mr. and Mrs. James A. Higgs.

Exciting ladies program was planned and led by (in usual order), Mrs. William J. Knox Mrs. Earl J. Reeder, co-chairman; Mrs. William C. Gorman, co-chairman; Mrs. C. F. Wertz; and Mrs. Herbert J. Morrison.

Board of Direction members at Miami Beach Convention bedazzled one another with aloha shirts until contest was called to determine most daring apparel. Mrs. August DeWinkler, Jr., chairman of award committee, is handing the prize—an even louder shirt—to Dean Francis M. Dawson, of the University of Iowa Engineering College. Contestants, who appear to disapprove verdict, were (left to right) Gail A. Hathaway, George W. Burpee, Mercel J. Shelton and Norman R. Moore.



Daniel V. Terrell (left) is congratulated by President Huber on his nomination for 1954 President of ASCE.

Daniel V. Terrell Is Nominated for President of ASCE in 1954

Daniel V. Terrell, dean of the college of engineering and director of the Engineering Experiment Station at the University of Kentucky, was nominated for 1954 President of the Society by the Board of Direction at its Miami Beach meeting. His election will be effectuated by letter ballot of the membership at a later date.

Dean Terrell has spent his entire career in his native state, Kentucky. Graduated from the University of Kentucky in 1910 with the degree of bachelor of civil engineering, in 1914 he received the degree of civil engineer. After two years in railroad work (1910–1912) he returned to the University as professor of highway engineering. In 1917, while serving as acting dean of the college of civil engineering, he was instrumental in the consolidation of three separate colleges into a college of engineering. From 1917 to 1942 he was professor of civil engineering and head of the department, and from 1942 to 1946, assistant dean. Since 1946 he has been dean of the college of engineering and director of the Engineering Experiment Station.

As a special service to the University, he designed and constructed the University stadium in 1924 and 1925, and has since served as general consultant on campus planning and construction.

Dean Terrell has executed many special engagements for the state. As early as 1914 he established and conducted road conferences at the University of Kentucky and developed a plan for state aid to counties, which formed a lasting foundation for the Kentucky State Highway Department. In summer work, he served the department from 1917 to 1928 as engineer of tests, and from 1928 to 1931 as research engineer. Since 1942 he has been director of the State Highway Research Laboratory. He was active in the early good-roads movement in Kentucky, and later supported the program for greater industrial development through research and more effective use of the state's natural resources. In 1944 and 1945 he was a member of the governor's Postwar Advisory Planning Commission. Since 1946 he has been a member of the State Board of Examiners and Registration of Architects, and also of the State Board for Registration of Professional Engineers.

In 1949 he received a Certificate of Service and a 35-year pin from the Kentucky Department of Highways, and Certificates of Achievement from the Louisville and the Lexington Automobile Clubs. In 1951 and 1952 he organized the Engineering Guidance Committee work in Kentucky and was instrumental in forming a number of Future Engineers Clubs.

In the field of federal service, Dean Terrell was state representative on local control surveys for the U. S. Coast and Geodetic Survey from 1933 to 1934; University of Kentucky representative on the Engineering, Science, Management, War Training Program from 1940 to 1945; administrator of the Engineers School, Enlisted Specialist Branch, from 1942 to 1943; and engineering administrator of the Army Specialized Training Program from 1943 to 1945. He organized both an undergraduate and a graduate program in highway education, which are proving successful.

Dean Terrell became an Associate Member of the Society in 1919, and a Member in 1926. He is a charter member and former president of the Kentucky Section of the Society, and in 1921 organized the University of Kentucky Student Chapter, one of the Society's early Chapters. As ASCE Director from 1947 to 1950, he planned and directed formation of the District 9 Council. In 1951–1952 he was Vice President from Zone III.

He has served as president of the Kentucky Society for Professional Engineers, and also holds membership in the American Society for Engineering Education (serving as Chairman, South East Section, 1952–1953), the American Society for Testing Materials (on which he represents the University of Kentucky and the Kentucky State Highway Department), Tau Beta Pi, Sigma Xi, Triangle, and the University of Kentucky Research Club.

Actions of Board of Direction at Miami Beach Briefed

All members of the ASCE Board of Direction were present at its Miami Beach meeting on June 15–16, 1953. The principal actions taken by the Board at this two-day meeting are summarized below.

Prizes and Awards

The Board approved the recommendations of the Prize Committee for 1953 prizes and awards, as listed elsewhere in this section.

Honorary Members Elected

The following were elected by the Board to Honorary Membership in the Society: Othmar H. Ammann, Arthur E. Morgan, Charles M. Spofford, and John C. Page.

Freeman Fund Award Made

On recommendation of the Freeman Fund Committee, the award for 1953 was granted to Capt. Ira A. Hunt, J.M. ASCE, U. S. Army. Captain Hunt's plan includes hydraulic research to be done at Grenoble, France.

J. Waldo Smith Hydraulic Fellowship Awarded

The J. Waldo Smith Hydraulic Fellowship was awarded to Robert E.

Templeton, member of the Student Chapter at Carnegie Institute of Technology, Pittsburgh, Pa., for his proposed study of "Scale Relationships for Air Entrainment," which he plans to undertake as a graduate student at Carnegie Institute of Technology beginning in September 1953.

Daniel W. Mead Contest Subjects Selected

On recommendation of the Committee on Professional Conduct, the Board approved the following subjects for the 1954 contests:

For Junior Members, "Ethics of the Resident Engineer in His Relations with the Contractor"

For Students, "To What Extent Should an Employer or Supervisor Give Credit to Assistants and Subordinates for Engineering Work Done Under His Supervision?"

Engineering Education

In considering the action taken by the National Council of State Boards of Engineering Examiners at its 31st annual meeting at Colorado Springs in 1952, the Board expressed its opinion as follows:

"Experience acquired under the direct supervision of a registered or licensed engineer does not guarantee that experience so acquired will be of such a nature as to benefit the young engineer who wishes to enter the educational field." The Board expressed its belief that since there are many fields of service in which registration is not required, valuable experience can be acquired under engineers who are not registered, and also while carrying out work for which registration is not a prerequisite.

In connection with a proposal to establish courses in construction engineering, the Board expressed disapproval of any further overspecialization, or splinter courses, in the field of undergraduate education.

Junior Members Encouraged to Register

The Board concurred in a recommendation of the Committee on Juniors that young engineers should be encouraged to secure their professional licenses as early as possible. It suggested that Local Sections take steps to assist them in attaining this goal.

Questionnaire on Employment Conditions Authorized

On recommendation of the Committee on Employment Conditions, and with the concurrence of the Committee on Conditions of Practice, the Board authorized a mail survey of all U.S. members of the Society to learn how many belong to collective bargaining groups, and to ascertain their attitude on the general subject of unionization of engineers.

Zone Boundaries Studied

The Board received a report by its Committee on Districts and Zones, looking toward changes in the boundaries of the four vice-presidential Zones of the Society. Details of the recommendations are presented on another page of this section.

Appointments to Technical Division Executive Committees Made

The Board approved the following appointments to Division Executive Committees:

Air Transport	Joseph D. Blatt
Construction	John P. Hart
Engineering Mechanics	John S. McNown
Hydraulics	W. M. Lansford
Sanitary Engineering	Richard Hazen
Soil Mechanics and Foundations	Ralph B. Peck
Structural	Warren Raeder
Surveying and Mapping	Oscar C. J. Marshall

Appointments

Prof. Ralph W. Powell to the Freeman Fund Committee; Prof. Hunter Rouse, to the J. Waldo Smith Hydraulic Fellowship Committee; Walter L. Huber, to the John Fritz Medal Board of Award; Thomas M. Riddick, to the Inter-Society Corrosion Committee; Harry F. Thomson, chairman, Maurice Barron and Prof. E. A. Gramstorff, as a committee to review papers eligible for the Alfred Noble Prize; R. A. Hill, to the Committee on Professional Practice; and Prof. I. W. Santry, to the Committee on Engineering Education.

ASCE Prizes and Awards Are Announced by Board

On recommendation of the Society's Committee on Prizes, the Board of Direction at its Miami Beach meeting, approved the following awards and prizes for papers published in Volume 117 (1952) of Transactions. Presentation will be made at ceremonies held during the Annual Convention in New York in October. Further details, together with brief biographies, will appear in a later issue of Civil Engineering.

Norman Medal

Friedrich Bleich, M. ASCE (deceased), and L. W. Teller, M. ASCE, for Paper 2486, "Structural Damping in Suspension Bridges."

J. James R. Croes Medal

Paul Rogers, M. ASCE, for Paper 2507, "Design of Large Coal Bunkers."

Thomas Fitch Rowland Prize

E. Montford Fucik, A.M. ASCE, for Paper 2505, "Petenwell Hydroelectric Project."

James Laurie Prize

Harold N. Fisk, for Paper 2511, "Mississippi River Valley Geology Relation to River Regime."

Arthur M. Wellington Prize

L. A. Nees, A.M. ASCE, for Paper 2523, "Pile Foundations for Large Towers on Permafrost."

Collingwood Prize for Juniors

Kuang-Han Chu, J.M. ASCE, for Paper 2494, "Truss Deflections by the Coordinate Method."

On recommendation of the Technical Division Prize Committees, the Board approved the following awards:

Karl Emil Hilgard Prize

Arthur T. Ippen, M. ASCE, for Paper 2434-A (Volume 116-1951), "Mechanics of Supercritical Flow."

Leon S. Moisseiff Award

Arthur W. Anderson, John A. Blume, M. ASCE, Henry J. Degenkolb, M. ASCE, Harold B. Hammill, M. ASCE, Edward M. Knapik, M. ASCE, Henry L. Marchand, Henry C. Powers, John E. Rinne, M. ASCE, George A. Sedgwick, A.M. ASCE, and Harold O. Sjoberg, A.M. ASCE, for Paper 2514, "Lateral Forces of Earthquake and Wind."

Construction Engineering Prize

Ben C. Gerwick, Jr., A.M. ASCE, for paper in April 1953 issue of Civil Engineering, "Transmission-line Piers Built Under Water Without Cofferdams."

Rudolph Hering Medal

Ralph Stone, A.M. ASCE, and William F. Garber, for Paper 2530, "Sewage Reclamation by Spreading Basin Infiltration."

No awards were made in 1953 for the James W. Rickey Medal or the J. C. Stevens Award.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE **Field Representative ASCE**

Legislation

In hearings before the House Ways and Means Committee several tax law revisions of interest to engineers will be discussed. One involves the establishment of tax-favored retirement funds for professional men and other self-employed groups. Income tax deductions would be permitted for sums spent on the purchase of certain bonds. Some engineers would also be affected by a proposal to abolish the present income tax exemption on earnings during a minimum period of seventeen months out of the country. Demand for this proposal has been brought about in considerable part by the tax exemptions of highly paid motion picture stars making pictures abroad. Persons establishing bona fide residence abroad would not be affected. Engineers Joint Council is now studying the situation preparatory to presenting testimony on behalf of all engineers.

Despite the introduction of several bills and extensive hearings, it appears likely that no amendments to the Taft-Hartley Act will be made.

The St. Lawrence Seaway legislation continues on its difficult road through committees. The House Public Works Committee voted to start hearings during June, but agreed it would not vote on the legislation, H. J. Res. 104, until and unless the Senate approves the project. The more sympathetic Senate Foreign Relations Committee has approved S. 589, which would authorize United States participation in the project. It is unlikely that any legislation on this will be enacted at this session.

The "Wunderlich case" situation, concerning the right of appeal in disputes on government contracts has been followed in this column for the past year. S. 24, providing for such court review has been passed by the Senate. The ASCE National Affairs Committee has sent a communication to the House Judiciary Committee urging the passage of the companion House bill.

Closely related to this matter is the "disputes clause" proposed in a new Government Construction Contract, Form 23. President Huber has sent a letter to the new General Services Administrator urging that the "disputes clause" provide for judicial review by following the provisions of S. 24.

Government Reorganization

The relations between the states and the federal government may eventually be changed, as a fundamental part of plans for reorganization. The Field Representative served as an observer for the Society at a National Conference on Federal-State Relations sponsored by the Chamber of Commerce of the United States. Senators, Congressmen and experts in the field of state affairs discussed the present federal grants to states and some proposed fundamental revisions. The topic of greatest interest to civil engineers was the suggestion to return the federal gasoline taxing power to the states and the various proposals as to where the Bureau of Public Roads would fit into the overall highway picture if this were done. The Conference of Governors and a proposed federal commission that may be set up would thoroughly explore the whole problem.

Obviously a considerable measure of control is given to the grantor of a grant-in-aid. Sometimes a 5 or 10-percent grant has given control to the grantor. The Conference urged the federal government to return the control to the states and also to hand over the particular taxing power from which the grant was paid. We must have a better evaluation of the federal interest and stake in the various projects on which the $2 billion in grants are paid.

Reorganization Plan No. 7 of 1953 would make some sweeping changes in carrying on various foreign operations. A Foreign Operations Administration would be set up to take over the functions of the Mutual Security Agency and the Technical Cooperation program of aid to underdeveloped countries—the so-called Point 4 program.

The Secretary of State would set overall policies but would not be involved in operating functions. In general the Point 4 program, under the State Department, has been disappointing to engineers, although proclaimed as a great engineering program. Some government bureaus have supplied engineering personnel for overseas work, especially the Bureau of Reclamation in connection with advising on irrigation. A few important contracts have been let for engineering development, but most emphasis has been on urgent relief programs to combat disease and under-nourishment, spreading the somewhat meager funds quite thinly. Agricultural rather than engineering experts have administered the program. Improved direction may be brought about by the proposed transfer. The plan becomes effective August 1, unless rejected by either branch of the Congress.

Another reorganization plan provides for revamping the controversial Council of Economic Advisers. Provision is made for an advisory board which would canvass the economic thinking of business, labor, farm, government and other leaders.

Studies of operations in the Bureau of Public Roads and in the Bureau of the Budget are being made with a view to effecting some reorganization by the heads of these bureaus.

A meeting of the Committee on Professional Practice was held during the Miami Beach Convention of the Society just concluded. One of the principal topics of discussion was a case of soliciting bids for professional engineering services by a federal agency. Oddly enough, the project is located in Miami, hence the committee heard first-hand accounts of the situation.

Miami Beach, Fla.

June 20, 1953

Data for ASCE Membership Directory Requested

The next Membership Directory will be issued early in 1954. It will carry address data of record in the Society's files as of September 30, 1953. In order that the Directory may be as complete and useful as possible, all members who have not furnished the headquarters office with up-to-date personal information are urged to do so. The information should include (1) full name, (2) name and address of organization with which associated, (3) title of position with the organization, (4) complete residence address, and (5) indication of mailing address to be used—business or residence.

Postal card requests for reporting changes of address will not be sent to members. Each one will be responsible for supplying information as to change of address or occupation. In order to meet production schedules, changes recorded later than September 30 cannot be carried in the Directory.

For the convenience of members, the coupon on page 86 of this issue may be used.

Engineering Salaries Discussed by ASCE–AGC Joint Cooperative Committee

Topics of mutual concern to engineers and contractors discussed at the May 27 meeting of the ASCE-AGC Joint Cooperative Committee included engineering salaries. The committee endorsed an AGC resolution, made at its recent 34th annual meeting in Miami: "Because the salaries paid to construction engineers employed by municipalities and many other governmental organizations are not sufficient to maintain sufficient staffs of competent and trained personnel necessary to design and administer construction programs in the most economical manner, the Associated General Contractors of America . . . recommends that engineers administering such construction programs be paid salaries commensurate with their responsibilities and commensurate with salaries paid by private industry."

The Committee urged close cooperation between local groups of both AGC and ASCE working towards an increase in the salary levels of engineers in the public service. The committee further stated that current increases in engineer salaries are mostly in the lower grades, and efforts should be made to raise salaries of engineers in all grades.

In noting that the 1953 freshman class in engineering was 30.5 percent greater than in the previous year and the third largest class ever to enter engineering school, the Joint Cooperative Committee commended the work of the Engineering Manpower Commission in making the shortage of engineers known. However, the Committee warned that although there is a great demand for engineers, professional standards must not be permitted to fall.

Active support of a Construction Division program to promote membership in ASCE of engineers employed by contractors was also urged.

The Joint Cooperative Committee reaffirmed its opposition to the practice of governmental agencies requiring contractors to submit alternate designs. It was agreed that alternate designs are difficult to evaluate and generally serve to delay construction programs. Furthermore, the cost of such evaluation is significant. Active support of legislation remedying the inequalities of the Wunderlich decision regarding the right of appeal to the Court of Claims was also endorsed.

Attending meeting of ASCE-AGC Joint Cooperative Committee are (seated left to right) C. B. Molineaux; D. R. Agnew; A. S. Macdonald; D. W. Winkelman, co-chairman and past-president AGC; Gail A. Hathaway, co-chairman and Past-President ASCE; A. S. Horner, past-president AGC; M. C. Prichard; and E. L. Macdonald. Standing, in same order, A. N. Carter, co-secretary; J. D. Marshall, R. K. Lockwood, acting co-secretary; and A. E. Poole.

District 9 Convention Held in Kentucky

The second annual convention of the District 9 Council of Sections—held at Cumberland Falls State Park in Kentucky, May 15 and 16—featured presentation of papers in competition for the first Daniel V. Terrell Award, two technical sessions, and a varied recreational program. Seven of the eight Local Sections in the District were represented in the attendance of 137 members and their families and guests. The Kentucky Section was host to the group, and the other Sections taking part were Central Ohio, Cincinnati, Cleveland, Dayton, Indiana, and Toledo.

Speakers at a technical session devoted to problems of water use and control were Orville Chinn, director of the Kentucky Flood Control and Water Usage Division of the Department of Conservation, and James S. Bowman, chief water control planning engineer for the Tennessee Valley Authority. Principal speaker at another session was Ernest E. Howard, Past-President of ASCE and consulting engineer of Kansas City, with a talk on "The Development of Toll Highways." Addressing other sessions were Warren Parks, ASCE Director for District 9, and Don Reynolds, assistant to the Secretary of ASCE.

Saturday morning was devoted to inspection of Wolf Creek Dam, followed by lunch at the Lodge in Cumberland State Park. In addition, the recreational program offered boat trips, hikes, and the

Prominent members and guests attending second annual convention of District 9 Council are (left to right) Warren K. Parks, ASCE Director for District 9; Dean D. V. Terrell, University of Kentucky College of Engineering; ASCE Past-President Ernest E. Howard, Kansas City consultant and one of technical session speakers; Don P. Reynolds, assistant to the Secretary of ASCE; and C. Russell Dole, chairman of District 9 Council.

annual dinner followed by a Kentucky square dance.

Highlighting the annual dinner was the presentation of papers submitted by Junior Members in the District in competition for the first Daniel V. Terrell Award, established for the dual purpose of encouraging Junior Member interest in the Society and honoring Dean Terrell's many years of service to the Society and, more especially, his leadership in establishing the District 9 Council. A number of papers of high quality were produced. The subject on which they all wrote was: "ASCE—My Observations of the Society." The paper by John E. Heer, Jr., instructor at the Speed Scientific School and member of the Kentucky Section, was adjudged most outstanding in the contest, and is abstracted below.

ASCE—My Observations of the Society

First Daniel V. Terrell Award
Won by John E. Heer, Jr.

Mr. Heer based his observations on two points of view. "First, what can the membership expect of the Society? Second, what has the Society a right to expect from its members in return?" Considering the first point, Mr. Heer said, "We must realize that some of the greatest problems facing the profession today are in economics and public relations. The Society should take its proper place in these fields. The societies can no longer devote themselves exclusively to matters of a technical nature. They must give more thought to such things as registration laws, merit systems in civil service, adequate salaries, unionization of engineers and similar problems of a humanistic nature. No longer can they be indifferent to the social impact and cultural repercussions of the works and inventions of the engineer.

"The Society is the recognized spokesman for a large and learned profession and as such it should have among its members a large percentage of those qualified for membership. The Society should continue its efforts to enroll all qualified in the grade of Junior Member as soon as they graduate. The Society will find it necessary to give this group the strength and protection that is needed to resist the assumption of its rights by unwarranted subprofessional groups.

"With the majority of the membership in the category of salaried employees, it is obvious that the Society must continue to study the economic status of the engineer. This might be considered by some to be a selfish point of view. A broader viewpoint demonstrates that far from being a selfish interest on the part of the profession, improvement of the economic status of the engineer is necessary. . . . The Society must participate in the education of its own members in the legal and economic elements of collective bargaining. There are nearly 30,000 engineers in active labor unions for engineers and scientists today. While it is true that less than 2,000 civil engineers are members of labor unions, this is probably due more to the nature of the civil engineer's work than to the efforts of the Society to date.

"I do not believe that many of us would want the Society to take a concrete stand on either side of this issue. However, we have every right to expect the Society to take the lead in acquainting its members with the facts on both sides, the issues involved being too vital to each of us and to the profession as a whole for toleration of a wait-and-see attitude."

In his observations of what the Society has a right to expect from its members, Mr. Heer quoted from the late W. E. Wickenden's widely circulated lecture, *The Second Mile:* "No professional man can evade the obligation to contribute to the advancement of his group. . . . His knowledge is to be regarded as part of a common fund built up over the generations, an inheritance which he freely shares and to which he is obligated to add; hence his duty to publish freely the fruits of research and to share the advances in professional technique."

C. Russell Dole (left), Chairman of District 9 Council, presents a plaque to John E. Heer, Jr., member of Kentucky Section, whose paper was judged best in the competition for the first D. V. Terrell Award.

"Many of us," Mr. Heer stated, "might well ponder these words the next time we are inclined to complain of the magnitude of the dues of our professional societies. Can we afford to, or do we even have the right to attempt to put the dollar sign on every activity of the Society? What just amount can be assessed against us each year as interest charges for drawing against this common fund of engineering knowledge built up over the past 3,000 years.

"The Society also has a right to expect its members to serve in both technical and civic capacities. The work in the field of professional improvements can no longer be left to a few committees. The advancements are an obligation of the membership as a whole. Much of this work must be done at the local level and some by the younger members. Almost all the Local Sections have technical and social programs in which the participation of all is needed.

"By serving on committees at both the local and national levels, members will be confronted with local civic and political problems, and will find an opportunity for public service. The engineer does not yet fully realize that his usefulness to humanity would be enormously increased if he would approach civic problems with the same earnestness with which he solves technical problems."

In speaking of the future of ASCE as it enters its second century, Mr. Heer urged increased attention to seeking more members. Of the 580,000 engineers of all branches in the country at the end of 1952, only 125,000, or 21.5 percent, were members of a professional society. Furthermore, he said, "at the present time, only one third of all the civil engineers in the country are members of the Society."

Mr. Heer then quoted statistics proving, "First, that if an engineer is not brought into the Society as a Junior Member upon graduation there is slight chance of his becoming a Member later on; second, that the rate of conversion from Junior Members to Associate Members is very low, with many men dropping their affiliation with the Society during their Junior Membership. Contact with these younger members for the most part is confined to the Local Sections. This makes it obvious that the Local Sections must become concerned with the problem of keeping the Junior Members' interest in the Society alive."

As a means of obtaining this end, Mr. Heer suggests more District Council conventions and large-scale meetings of the 14 ASCE Technical Divisions in various parts of the country, which the younger engineers could attend.

Society Publications a Unified Whole

In recent months much has appeared concerning improvements in the processing of the Society's technical publications. It is important for members to understand—and for the Society to reemphasize—this plan against the background of the Society's publication program as a unified whole.

ASCE welcomes papers and discussions on engineering subjects for publication, reserving the right to reject either papers or discussions, in whole or in part, and to edit those accepted, in accordance with standard regulations. Upon acceptance, all papers become the property of the Society. Policies regarding papers are under the direction of the Society's Committee on Publications.

Ordinarily papers for ASCE use fall into two groups—first, those illustrated descriptive articles, particularly those devoted to construction or professional matters, intended for publication in CIVIL ENGINEERING; and second, those of more studious nature, requiring discussion, and therefore suitable for Proceedings Separates and for TRANSACTIONS. Any paper delivered at a Society Convention is eligible for either use and the author may indicate a choice. Technical Divisions review and make recommendations regarding the Proceedings type of paper. Papers for TRANSACTIONS are selected from those published as Proceedings Separates.

Manuscripts of papers are to be typewritten double spaced, with generous margins, and on substantial bond paper. At least one copy must be an original. Illustrations and tables should be separately paged and captioned. They may be placed at the end of the manuscript.

Convention papers are solicited by the Technical Division and by them transmitted to Society Headquarters at least 45 days before the Convention. The editor of CIVIL ENGINEERING makes the first selection. The remaining papers, when so designated by a Division, will be reproduced as Proceedings Separates.

Civil Engineering

For CIVIL ENGINEERING, articles descriptive or pictorial in character, relatively short and free from highly mathematical treatment, are always welcome. Space is limited; competition is keen; and hence acceptance cannot be routine.

Length, exclusive of photographs, diagrams and tabular matter, is limited to about 3,000 words. Manuscripts for presentation at Conventions are to be transmitted through the appropriate Technical Division, but independent articles should be mailed directly to the editor of CIVIL ENGINEERING at Society Headquarters.

Proceedings Separates

Papers cleared by a Technical Division are published by photo-offset and, beginning in October 1953, will be mailed automatically to each member of the Division without charge. By a postcard canvass mailed in June, every member is being asked to enroll in the *one* Technical Division of his choice. A charge of twenty-five cents each is made for other papers, ordered by using the coupon in CIVIL ENGINEERING. A member of any Division may obtain automatic mailing of the Proceedings papers of other Divisions upon the payment of an annual subscription price of $2 per additional Division; or may obtain those of all Divisions at an annual subscription rate of $12.

For most rapid handling, such papers should be less than 18,000 words in length, including illustrations and tables. An average length of 12,000 words or their equivalent is planned for. The first Proceedings Separates to be reproduced by photo-offset were issued last month. Until October, however, they will continue to be distributed as in the past by coupon order blank, appearing in each issue of CIVIL ENGINEERING.

To assure the success of the automatic operation after October 15, members are urged to return their postcards promptly, with their choice of the *one* Technical Division indicated. The return postcard must not be dismissed lightly with the idea that previous registration for Division affiliation takes care of the situation. Members who did not receive a card in the June mailing should notify the Executive Secretary of their choice of the *one* Division and give their correct mailing address.

Proceedings papers should be submitted in a typewritten form that can be released directly to the photo-offset printer without editing or other alteration. It is important that all typing be contained within a frame $5^7/_8$ in. wide by $9^5/_8$ in. high, including the line reserved for the page number at the top of the frame. Illustrations and tabular matter must be supplied by the author in sharply contrasting black and white, and the sizes must conform to the frame dimensions described above.

A brief synopsis should preface the manuscript, giving the objects of the paper, a short digest of its contents, and a concise statement of its conclusions. The synopsis should be no longer than 300 words.

Discussions are welcome, and manuscript requirements for them are the same as for main papers. Discussions may be submitted any time within three months following the date of publication of the main paper.

Papers to be read at Society Conventions can be processed as Proceedings Separates and produced in time for oral presentation if the manuscript is released by the sponsoring Technical Division and received by the Manager of Technical Publications not later than forty-five days prior to the Monday of the scheduled Convention week.

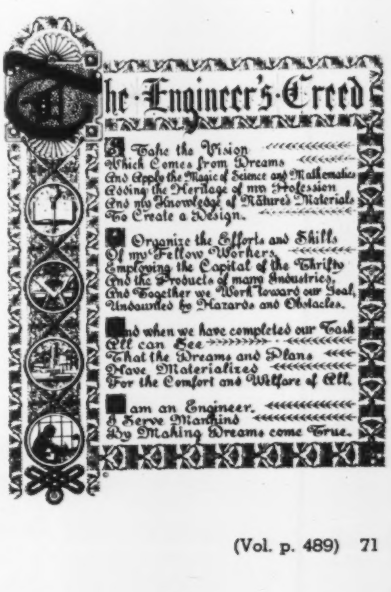
Transactions

Papers for TRANSACTIONS are carefully selected from the greater number previously printed as Proceedings Separates. Fundamentally, technical papers, results of research, and detailed analytical descriptions of completed projects—

Copies of Engineers Creed May Be Ordered

To meet continued demand for copies or reprints of "The Engineer's Creed," originally reproduced in the November 1948 issue (page 56), the Society is making available a new supply of the $8^1/_2$ by 11-in. de luxe reprints suitable for framing. The reprint, shown here in miniature, is made on a lightweight cream parchment. Author of the creed is Adolph J. Ackerman, M. ASCE, and the illumination is the work of Robert W. Hiller, mechanical engineer and artist of Pittsburgh, Pa.

Copies may be ordered at $1 each by means of the special blank in the advertising section (page 118). Special prices will be available for bulk orders.



The·Engineer's·Creed

I Take the Vision
Which Comes from Dreams
And Apply the Magic of Science and Mathematics
Adding the Heritage of my Profession
And my Knowledge of Nature's Materials
To Create a Design.

I Organize the Efforts and Skills
Of my Fellow Workers
Employing the Capital of the Thrifty
And the Products of many Industries,
And Together we Work toward our Goal,
Undaunted by Hazards and Obstacles.

And when we have completed our Task
All can See
That the Dreams and Plans
Have Materialized
For the Comfort and Welfare of All.

I am an Engineer.
I Serve Mankind
By Making Dreams come True.

hence generally those contributions deemed to be of permanent value—fall in the category of Transactions papers.

Originality and engineering usefulness in terms of content, clarity and conciseness in terms of form, are the main qualifications. A combination of high standards and limited space imposes limitations such that only the best of the good papers can be accommodated in Transactions.

Transactions papers are printed by letter-press methods, after careful editing. Discussions issued during the photo-offset stage are also edited to conform with the edited Transactions paper in this later and more deliberate phase of the program. The paper and the printed discussion, including the author's closure, will be collated and published in Transactions.

Reprints of Transactions papers are provided for single-copy sale at varying prices, according to relative length.

[See also June Civil Engineering, page 66, "Proceedings Separates to Be Photo-Offset."]

Los Angeles and St. Louis Sections Select Seven Wonders

Two more Sections—the Los Angeles and St. Louis—have selected the "Seven Wonders of Civil Engineering" in their areas. Set in motion last year as a feature of the Centennial of Engineering celebration, the "Seven Wonders" program has been undertaken by a number of Sections and has aroused considerable interest in the press. In announcing the results of the poll of Los Angeles Section members, Section President Trent R. Dames called attention to the fact that the Section includes eleven counties in California and Clark County in Nevada. Covering such a wide area, the Section was able to include some engineering marvels at considerable distance from the center of the city.

Feature of "First Wonder" of Los Angeles Section is the Intake Pumping Plant of the Metropolitan Water District Aqueduct, located on California shoreline of Lake Havasu, which is formed by Parker Dam. Here Colorado River water is lifted 291 ft into the first of a series of aqueduct tunnels to start its 457-mile journey across California to 48 cities in the Metropolitan Water District of Southern California.

Veteran Eads Bridge, across the Mississippi, is choice of St. Louis Section for the first wonder. It was also the first bridge across the Mississippi and the first to make extensive use of steel and alloy-steel in bridge construction.

The No. 1 Wonder is the Colorado River Aqueduct of the Metropolitan Water District of Southern California. Said to be the longest and largest domestic water supply line in the United States, the system includes a main aqueduct 242 miles in length, 92 miles of tunnels, 63 miles of concrete-lined canals, 55 miles of concrete conduits, and 29 miles of inverted siphons. It was financed by a $220,000,000 bond issue.

This project was followed in close order by the Hyperion Sewage Treatment Plant and the Los Angeles Municipal Collection System, with particular reference to the unusual length of the collectors; the Kaiser Steel Plant at Fontana; Pershing Square Underground Garage; Hoover Dam and Power Plant; the Los Angeles-Long Beach Harbor Development; and the Los Angeles County Flood Control System.

Other nominations that could be classified as the "Second Seven" were the Los Angeles Freeways (particularly the four-level structure at the intersection of the Hollywood and Harbor Freeways and the Colorado Freeway Bridge across the Arroyo Seco); the Hotel Statler; the Frank Weymouth Water Softening Plant at La Verne; the Owens Valley Aqueduct of the Los Angeles Department of Water and Power; the tremendous expansion of individual housing in the area; the Civic Center buildings, including General Hospital; and the many Armed Services testing facilities in the area.

A special committee of St. Louis Section members appointed to select the Seven Wonders for the St. Louis area has decided upon the time-honored Eads Bridge across the Mississippi as the first wonder. Designed and constructed under the supervision of Capt. James Buchanan Eads and completed in 1874, the 4,891-ft structure was the first bridge across the Mississippi. On its construction, pneumatic caissons were used for the first time in the United States in sinking the piers and the east abutment. The bridge also made the first extensive use of steel and alloy-steel in bridge construction in the United States and, to a large extent, established the practice of specifying the quality of materials required for engineering structures.

The other wonders in the St. Louis area are the St. Louis Union Station; the Chain of Rocks Filtration Plant (one of the earliest rapid sand filter plants at the time of its construction in 1915); the River Des Peres Drainage Channel; the Chain of Rocks Locks; the St. Louis Brewery of Anheuser-Busch; and the Meramec Power Plant of the Union Electric Co.

Zone Boundaries Studied

In accordance with the By-Laws, the Committee on Districts and Zones is required periodically to make recommendations to the Board, at the time of a summer Convention, with respect to changes in the boundaries of Districts and Zones. Such report when made may be received by the Board of Direction but the Board is not empowered to take action on the recommendation until the following Convention held in October.

At the Miami Beach meeting of the Board, the Committee on Districts and Zones recommended that steps be initiated looking toward a change in Article V, Section 4, of the Constitution and any other changes in the Constitution and By-Laws which would be required to change the boundaries of the four Zones of the Society on the basis of a nominal geographical division. These nominal Zones would be established without regard to the member population in them. Under this plan, Zone I would include the northeastern states; Zone II the southern states; Zone III the central states; and Zone IV the western states. The Zone boundaries recommended are shown in Fig. 1.

The Committee recommended that its proposed changes in Zone boundaries, if made effective, be not established until October 1, 1957. It recommended also that no changes in District boundaries be considered until a decision has been reached on its recommended changes in Zone boundaries.

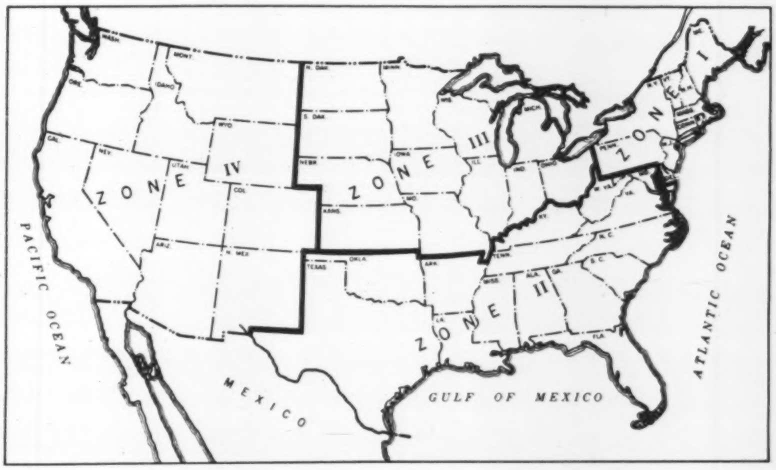


FIG. 1. Boundaries of Vice-Presidential Zones recommended by Committee on Districts and Zones and under consideration by Board of Direction.

It is expected that this important step will be amplified further in later issues of Civil Engineering, outlining the reasons for the proposed changes. At its meeting next October, during the New York Convention, the Board will consider further the recommendations made by the Committee and must then accept, reject, or modify them.

District 6 Council Holds First Meeting

Organization and policies of procedure were the principal concern of the first meeting of the District 6 Council, held at Clarksburg, W. Va., May 1, with the West Virginia Section as host. Delegates were present from the Maryland, Virginia, and West Virginia Sections, and it was agreed that participation of the Pittsburgh Section would be sought. Kenath A. Kettle, of the West Virginia Section, is temporary secretary.

Delegates attenting organizational meeting of District 6 Council are (seated, left to right) Kenath A. Kettle, West Virginia Section; ASCE Director George W. McAlpin; and Fred R. Palmer, West Virginia Section, Standing, in same order, are W. B. Spencer, Maryland Section, and P. A. Rice, Virginia Section.

ASCE Director for the District, George W. McAlpin, met with the delegates and led discussion of such matters as the rotation of the District directorship, the proposed redistricting plan, and the best means of keeping the Director for the District informed of Local Section problems and plans.

Those attending the initial meeting of the Council were highly enthusiastic as to its future and of the opinion that it will fill an important place in Section activities. A second meeting is planned for the late summer or early fall.

District 7 Council to Meet at Houghton, Mich.

The multi-faceted Mackinac Straits Bridge will be the major subject of discussion at a two-day conference of the District 7 Council, to be held at the Michigan College of Mining and Technology Houghton, Mich., on August 6 and 7 with the Michigan Section as host. Dr. D. B. Steinman, designer of the bridge, will address the opening session, and an entire afternoon will be devoted to a symposium covering the history, foundations, superstructure, and financing of the project. Other sessions and the August 6 luncheon program will explore the history of the copper country.

There will be a general session on Friday morning, August 7, with papers on the White Pine Copper Development, the International Bridge at Sault Ste Marie, and a large Canadian pipeline development. The effect of these developments on industry, business, and recreation in the Upper Peninsula and the Northwest will be summarized by Dr. Grover C. Dillman, president of Michigan College of Mining and Technology.

The Council's annual business meeting on Friday afternoon will include a symposium on ASCE affairs and a report on the Miami Convention, to be given by Lloyd D. Knapp, ASCE Director for the District, and G. Brooks Earnest, Vice-President for Zone III.

Special outdoor activities being planned will make the conference more than just another engineering meeting.

Tennessee Valley Section Has Two-Day Spring Meeting

Asheville in its beautiful mountain setting was spring meeting place for the Tennessee Valley Section, to which the Subsection there was host on May 15 and 16. An unusually varied program that ranged from an address by Lt. Gen. Robert L. Eichelberger on Korea and the Far East to a trip up Mt. Mitchell, drew an attendance of about 50 Section members and their wives and families. Franklin McMillan, Subsection president, and Chairman Al Goodwin were in general charge of the program.

The business session, with Section President Clifford A. Betts in the chair, unanimously endorsed the method recently adopted by the District 10 Council for selecting candidates for Director. Lewis A. Schmidt, Jr., speaking for a Section committee, presented a discussion of the study of expanding Society services, reported by the ASCE Task Committee in the April issue (page 71). The group also greeted Thomas J. Cox and Paul H. Wright, seniors in civil engineering and members of the University of Tennessee Student Chapter, who were this year's winners of the Section's student awards.

In addition to General Eichelberger's interesting analysis of the Korean situation, which featured the luncheon program, there was a technical session with talks by A. H. Williams, assistant chief of the Surface Water Branch of the U.S. Geological Survey, and C. E. Proudley, chief materials engineer of the North Carolina Highway and Public Works Commission. Mr. Williams dealt with water as a basic resource and a renewable resource, and Mr. Proudley described outstanding construction features of the Ridgecrest-Old Fort cutoff highway—a recent project that eliminated almost 70 curves in an eight-mile stretch. Also of much interest to the group was the after-dinner address on economic recovery in Europe by Norman H. Collisson, who described the Marshall Plan as "literally an insurance policy for us" rather than charity.

Seen at two-day spring meeting of Tennessee Valley Section in Asheville are Edmund Friedman, ASCE Vice-President for Zone II; A. H. Williams, one of technical session speakers; Franklin McMillan, president of Asheville Subsection; and Clifford A. Betts, president of Tennessee Valley Section.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

An investigation of possible air-raid shelters occupied the attention of the **Anchorage Subsection** of the **Alaska Section** at its May 11 meeting, when it was decided that inspection teams should be named to look into this matter. At the dinner meeting of the **Juneau Subsection** on May 26, Keith Boyd, past-president of the Section, spoke on his assignment in the Snow, Ice and Permafrost Research Establishment, as chief of the Frozen Ground Applied Research Branch. Then Hugh A. Stoddart, division engineer with the Bureau of Public Roads, discussed some of the problems facing the Bureau and its policies in meeting these problems.

Improvement of the Buffalo Municipal Airport was the subject presented to the members of the **Buffalo Section** at their luncheon meeting on May 19. The speaker was Harry T. Hopewell, vice-president of Thos. B. Bourne Associates, of Washington, D.C., who dealt with the overall long-range plan for the development of the airport.

Military construction in Korea was the subject of the illustrated talk enjoyed by the **Columbia Section** at its meeting on May 14. The speaker, Col. Fremont S. Tandy, district engineer of the Walla Walla District, Corps of Engineers, discussed highlights of his 18-month tour of duty in Korea as commanding officer of the 32nd Engineer Construction Group, when he directed repair of 275 miles of battle-torn railway and railway bridges, construction of 375 miles of primary military highways, and the building of hospitals and cantonments.

A tour of the Clark Hill Powerhouse, now under construction by the Corps of Engineers on the Savannah River, constituted the May meeting of the **Central Savannah River Subsection** of the **Georgia Section.** Following the tour, a plate supper was served at the job cafeteria.

ASCE MEMBERSHIP AS OF JUNE 9, 1953

Members	8,360
Associate Members	10,632
Junior Members	17,169
Affiliates	69
Honorary Members	40
Total	36,270
(June 9, 1952	34,843)

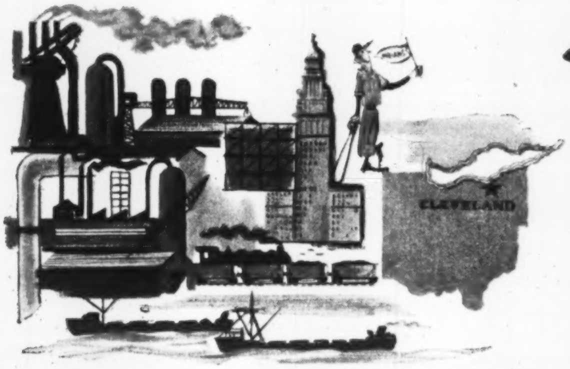
"Treatment of Pavement for Snow Removal," prize-winning paper in the student competition held in Denver, was presented at the May meeting of the **Intermountain Section** by its author, Orvil Israelsen, a student from the Utah State Agricultural College. The main speaker of the evening was Elmo R. Morgan, vice-president of business administration at the University of Utah, who spoke on "The Engineer and the World in Which He Lives."

New officers for the **Ithaca Section,** elected at its May 7 meeting are: James A. Norris, president; Bruno Chape, first vice-president; Marvin Bogema, second vice-president; and William L. Hewitt, secretary-treasurer. William C. Burnett of Cornell University received the Section's annual award of paid-up Junior membership in the Society. The address of the evening, on "Heavy Construction Work in Foreign Countries," was delivered by A. E. Cummings, director of research, Raymond Concrete Pile Co.

The **Kansas City Section,** at its May 12 meeting, announced the award of its honor certificate, carrying with it the dues for Junior membership in the Society, to Clay Robbins of the Missouri School of Mines and Metallurgy. The speaker of the evening, ASCE Director Francis M. Dawson, recounted his experiences in Pakistan teaching students of engineering.

Describing methods and materials used to construct the Chesapeake Bay Bridge, Ethan F. Ball, engineer with the Bethlehem Steel Co., delivered an illustrated lecture

Cleveland Prefers Concrete Pressure Pipe



Economy was a decisive factor in Cleveland's selection of concrete pressure pipe for its water supply system. This seventh ranking city in the nation, with an average daily water consumption of 272 mgd., found that the low original cost of concrete pressure pipe, together with its remarkably long life and excellent flow characteristics, made it a sound investment.

In 1940 the first concrete pressure pipe was laid in Cleveland. Since that time several additional installations have been made, one of these being the Nottingham intake. Here, 10,000 feet of 120 inch concrete pressure pipe was used. Just recently the Northfield Road Main was completed. This job, stretching for over 4 miles, used concrete pressure pipe in diameters ranging from 30 to 42 inches.

Efficient, economical concrete pressure pipe is available in a wide range of diameters and can be installed to fit the individual requirements of large or small communities.

Water for Generations to come

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228 North LaSalle Street
Chicago 1, Illinois

before members and their wives at the May technical meeting of the **Lehigh Valley Section.**

At its April meeting, the **Los Angeles Section** heard an address on "Modern and Stone Age Engineering," by Gen. L. J. Sverdrup, of the Corps of Engineers. At the May meeting a talk on "Seismology and the Southern California Engineer," by Al Dorman, graduate student at the University, was supplemented by a movie, "Proerty Line," produced by the University of Southern California cinema department. The Section has organized subsections at San Bernardino, Santa Ana, and Ventura; and officers have been elected. The desirability of establishing subsections at San Luis Obispo, Inyo-Kern, and Boulder City, Nev., is being contemplated.

The first formal meeting of the **New Hampshire Branch** of the **Maine Section** was held in Concord, N.H., on May 27, with 33 members and guests in attendance. Officers elected were: John O. Morton, Concord, president; John H. Minnich, Hanover, vice-president; and Warren F. Daniell, Jr., Concord, secretary-treasurer. Speaker of the evening, Dr. Charles F. Goodrich, a former Director of ASCE and formerly chief engineer of the American Bridge Co., enlivened his talk on the history of bridge engineering with many personal anecdotes.

At the May 19 meeting of the **Mexico Section,** approval was given to the formation of groups to keep in touch with the various Technical Divisions of the Society, and to the formation of a student organization at the National University of Mexico. The speaker of the evening, Engineer Jose Vicente Orozco, described engineering works in the state of Papaloapan, Mexico.

Two student speakers from the University of Miami read papers at the April meeting of the **Miami Section.** Ellis Hollums' paper, on "Bond Strength of Coated Reinforcing Bars," accompanied with charts for illustration, was selected for presentation at the 37th annual convention of the Florida Engineering Society in Tampa, and given the Section's $25 award. The paper by Dominic Cassella, "Prestressed Concrete Reinforcing Anchorage," which he illustrated on the blackboard, received the Section's $15 award. These presentations were followed by a showing of "Adam to Atom."

Featured at the April meeting of the **Jackson Branch** of the **Mid-South Section** were a talk on "The Future Possibilities of Atomic Energy for Industry," by E. F. Bespalow, president of the Section; and a short talk on national ASCE activities, by Norman R. Moore, Director from District 14. The **Little Rock Branch** held its regular quarterly meeting on May 20. Following the appointment of standing committees and other business, a Chinese engineer, Huang Wong Tsein, with the bureau of highways of the Nationalist Chinese Government of Formosa, gave a talk on that island. He is on a year's assignment in the United States studying highway construction. A talk on flexible pavement by Charles R. Foster, chief of the Flexible Pavement Branch of the Waterways Experiment Station, was featured at the April luncheon meeting of the **Vicksburg Branch.**

Interesting aspects of Nebraska geology were described by J. D. Bates, geologist for the Bureau of Reclamation, at the May meeting of the **Nebraska Section.** During the business portion of the meeting, items covered during the recent meeting of the Section's Executive Board with William N. Carey, Executive Secretary of ASCE, were relayed to the group.

At joint meeting of Case Student Chapter, Cleveland Section of Society, and Fenn Student Chapter, Richard Eppink (right) receives Chapter award for "his unselfish work during the year" from Norman Cox, retiring Chapter president, while other Chapter members look on. Program for the evening, planned by senior members of the Case Student Chapter, consisted of movies and slides made during last year's Junior Member inspection trip. Movies were supplied by Joe Oppenlander, and slides by Norman Cox, Ray Conrad, and Bob Johns. George Ikeda has been elected Chapter president for next year.

One third of the population of the United States served by public water supplies was short of water last year, according to E. J. Umbenhauer, superintendent of water and sewerage at El Paso, Tex., dinner speaker at the April 24–25 meeting of the **New Mexico Section.** In the student paper contest, Don Wigal, University of New Mexico, won first prize of $25; Tony G. Conde, of Texas Western, received the second prize of $15; and Ramon Woodside, of New Mexico Agricultural and Mechanical Arts College, tied with Carl J. Smith, of Texas Technological Institute, for third prize—$10 to each.

At the annual dinner meeting of the **Providence Section,** Daniel C. Drucker, last year's vice-president, was elected president; Edgar P. Snow, vice-president; and Harold Bateson, secretary-treasurer. A lively talk on "The Use of Scientific Methods in Detection of Crime," was given by Dr. Harold C. Harrison, assistant director of the University of Rhode Island Laboratories for Scientific Criminal Investigations.

Recent speakers before meetings of the **Rochester Section** include the following: Elmer G. H. Youngman, district engineer for the New York State Department of Public Works, who discussed planning and design of New York State highways and thruways, describing the network in that part of the state and some of the Department's largest jobs; Robert Menzie, executive secretary of the Citizens Tax League, who spoke on the subject, "What About a Rochester Metropolitan District?" outlining accomplishments to date and the functions best handled by such a district; and Arthur Miller, of the A. O. Smith Corp., who dealt with problems of airframe design and construction, including loading conditions, welding, and stress analysis, with the aid of slides.

Among recent speakers heard by the **Sacramento Section** at its weekly luncheon meetings was Arthur Showman of the U.S. Engineer Department, who talked about the military construction program in the Sacramento District of the Corps of Engineers. He said that the authorized work since 1951 totaled about $130,000,000, but that the District faces 1954 with only $5 or $6 millions of military work as a result of the Administration's economy moves. Lack of cooperation on the part of the weather in no way dampened the spirits of the **Shasta Subsection** of the Sacramento Section at its meeting on May 22 and 23. In spite of rain, snow, hail, sleet and sunshine combined in unusual ways, the Friday night stag roast beef dinner was much enjoyed, as well as the filmed travelogue through Switzerland, Spain, and Redding that followed. For the barbecue the next day, 70-odd mountaineers climbed the slopes of the Cascades to snow-blanketed Viola.

Under the head, "Change Is Important," the **San Francisco Section's** new live-wire publication, *The Civil Engineer*, in its May issue gives some advice of general interest to Junior Members of the Society. It states:

HIGHWAY PROFILES AND GRADES...

even final cross sections...from AERO maps

Skilled AERO mappers, working with top precision tools like the new Wild Stereoplotter A-7 below, achieve accuracy that is expanding the uses of aerial photo maps.

On a major New England highway project, detailed AERO topographic maps with 1 ft. contour intervals were used for planning the center line profile and new highway grades.

Even the cross sections for developing bids for earth work were based on AERO contours. Checking by field surveys showed 90% of these contours to be accurate within ½ ft. in open areas.

A hair's breadth is a coarse dimension to this complex, $45,000 mapping instrument—so sensitive it's housed in an air-conditioned room. And in the field, AERO's T-3 theodolites provide precise ground control for aerial maps that put engineering projects years ahead—at a fraction of the cost of ground surveys.

Call on the 34 years experience of our photogrammetric engineers when you plan your next project.

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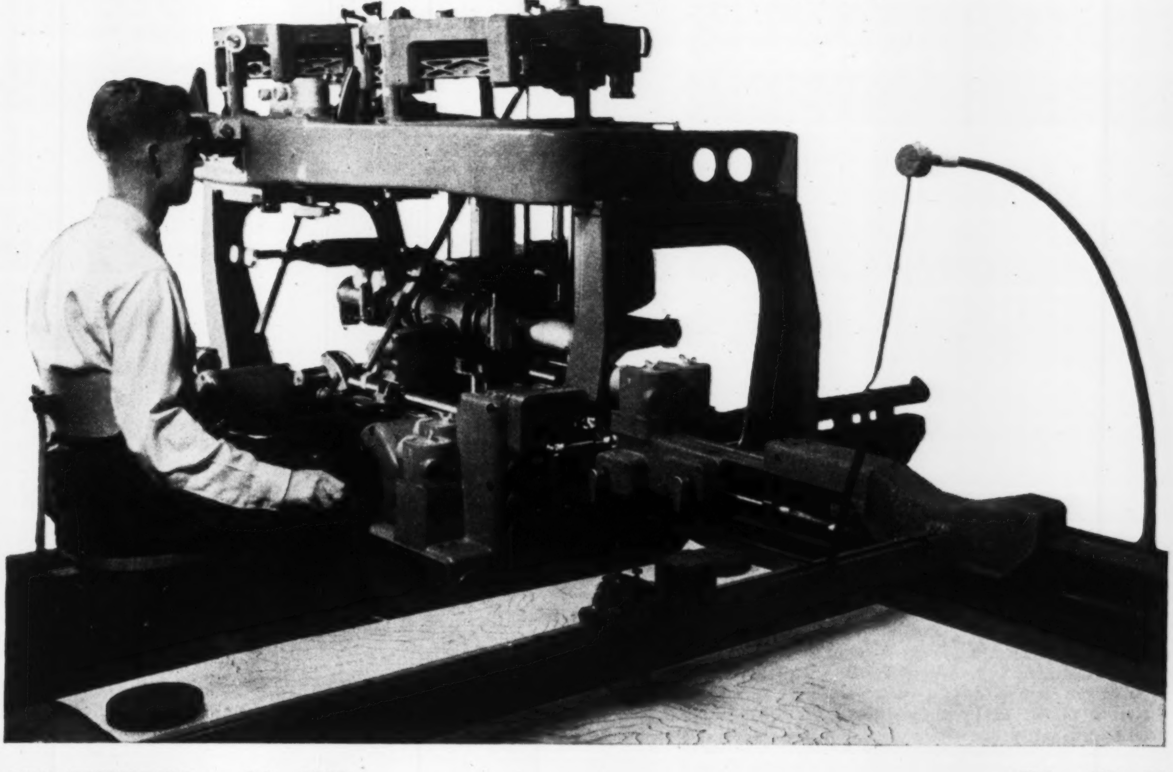
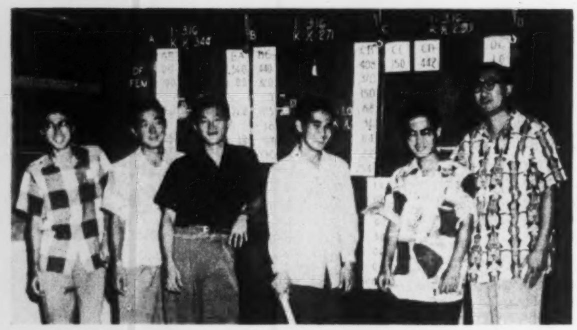
Oldest Flying Corporation in the World

AIRBORNE MAGNETOMETER SURVEYS
PRECISE AERIAL MOSAICS
TOPOGRAPHIC MAPS
PLANIMETRIC MAPS
RELIEF MODELS
SHORAN MAPPING





Student Chapter Host to Hawaii Section

Student Chapter of University of Hawaii was host to joint meeting of Chapter and Hawaii Section, held on the University campus on May 13. Ingenious model built by Chapter was used as a visual aid in lecture and demonstration of "Method of Moment Distribution as Developed by Hardy Cross," in which eight members of Chapter took part. They were, from left to right, Masayuki Minamide, Albert Tani, Calvin Mimaki, Yuji Kasamoto, Thomas Kawahara, and Robert Chun (with Edison Testerman and Melvin Thompson, not shown).

"Many of the young members do not fully . . . appreciate the consequences of being a member of the Society. The statement of an engineer that he is a Member of ASCE elevates that person to a level far above the average in his field of endeavor. This is particularly true where the engineer must meet the public, as in court cases or as a consultant. It seems appropriate, therefore, to advance to the grade of Member as rapidly as possible, both for the benefit of the individual and for the Society . . . .

"At the present time approximately 40.5 percent of the Society membership are Junior Members. These men pay yearly dues in the amount of one-half that paid by other members. However, this group now receives exactly the same benefits as the other members, except that Junior Members may not hold office at the national level . . . .

"Each individual Junior Member must search his mind to determine whether or not he has a moral and real responsibility to the Society. Can the answer to both questions be a transfer to Associate Member at the earliest opportunity? Was it an error to grant the Junior Members the power to vote? Are you riding on the back of others? What is your answer?"

The **Seattle Section** and the Vancouver Branch of the Engineering Institute of Canada enjoyed a joint meeting at Vancouver on May 23. A party of 50 represented the Seattle Section on a full day of inspection tours to three major Canadian engineering projects in the Vancouver area—the Granville Street Bridge, a cantilever structure now under construction; the Cleveland Dam under construction in the Capilano River Canyon, to be 325 ft high; and a model of the Fraser River at the University of British Columbia, being used to study navigation problems in the estuary. A well-planned evening program of dinner, movies and dancing concluded what was felt to be a most successful occasion.

Speakers at the May 8 meeting of the **Syracuse Section** were Prof. A. A. K. Booth, Director for District 3, who discussed graduate education for engineers, emphasizing the need for well educated men in all branches of engineering; and William N. Carey, Executive Secretary of ASCE, who brought the Section up to date on national activities of the Society. Earlier in the meeting two student prize winners had been announced—William E. Davies of Clarkson College, and Richard N. Wright of Syracuse University.

Texas water policy was the subject of the talk before the May 11 meeting of the **Texas Section's Fort Worth Branch.** This subject was presented by S. W. Freese, of Freese and Nichols, who as a member of the ASCE Water Policy Committee helped to formulate such policy. A project to enlarge the horizon of engineers and to encourage young engineers to take part in public affairs and civic activities has been launched by the **Houston Branch.** To effectuate this effort, a Development Committee has been working under the chairmanship of Walter E. Dickerson. As a first step, counselors in schools and colleges of the area have been contacted. At its April 28 meeting, the Houston Branch heard Frank Baldwin, M. A. Dillingham, Frank H. Newnam, Jr., and Nat P. Turner, Jr., present various phases of the Lake Houston water supply project. "Fundamentals of Prestressed Concrete and Different Methods of Stressing Concrete" was the subject of the principal speaker, H. C. Pfannkuche, of the Portland Cement Association, at the May 11 meeting of the **San Antonio Branch.**

The dinner meeting of the **Toledo Section** on April 1 was held in conjunction with the Toledo University Student Chapter at the University of Toledo. Following a short speech of welcome by Dr. Asa Knowles, president of the University, G. Brooks Earnest, Vice-President representing Zone III, spoke on Society activities at the national level.

An afternoon inspection of the operation of auger coal mining and the layout of the Hope Natural Gas Company's new shop and warehouse ushered in the spring meeting of the **West Virginia Section** held in Clarksburg on May 1. In the evening, after a social hour and dinner, members of the Student Chapter at West Virginia University were introduced and presented with an ASCE banner, gift of life members in the Section. The Section's award to the outstanding civil engineering graduate of the year went to Jack George, whose dues as a Junior Member of ASCE will be paid. The great and growing need for engineers in industry was the subject of a talk by E. D. Pilcher, plant manager for the National Carbon Co. He pointed out the need for education in, as well as interest beyond, the purely technical subjects.

Coming Events

Akron—Picnic at the cottage of M. P. Lauer, on the evening of July 30.

District 7 Council—Conference at Michigan College of Mining and Technology, Houghton, Mich., August 6 and 7.

Los Angeles—Junior Forum inspection trip through the Los Angeles Brewing Co., on July 11 at 10 a.m. Reservations are required and may be made by contacting Larry Coleman, Mi. 4211, ext. 456, before 9 a.m. on week days prior to July 7.

New Mexico—Summer meeting at Los Alamos, N. Mex., on July 25, will feature latest information about nuclear developments including civilian applications.

Northeastern—Luncheon meeting at the Boston City Club on July 15, at 12 noon.

Oklahoma—Fall meeting at Tulsa, Okla., on September 19.

Sacramento—Weekly luncheons every Tuesday at the Elks Temple, Sacramento, at 12 noon.

South Carolina—Annual summer meeting at the Cleveland Hotel, Spartanburg, S.C., July 24–25.

Tacoma—Annual family picnic at Pioneer Park on Long Lake, near Olympia, Wash., August 1.

Scheduled ASCE Conventions

NEW YORK CONVENTION
Hotel Statler
October 19–23
1953

ATLANTA CONVENTION
Atlanta, Ga.
Hotel Biltmore
February 15–19, 1954

ATLANTIC CITY CONVENTION
Atlantic City, N.J.
Chalfonte-Haddon Hall
June 14–19, 1954

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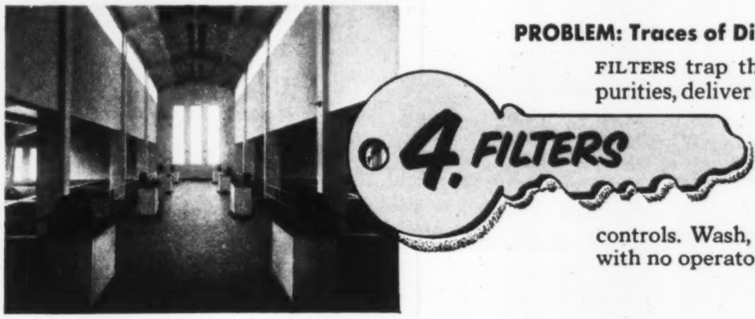

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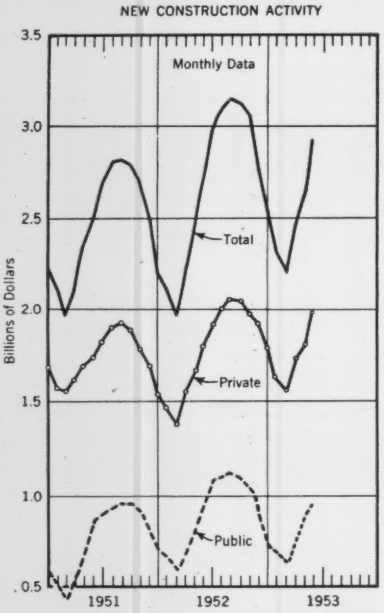
NEWS BRIEFS . . .

Construction Expenditures Rise 10 Percent in May

New construction expenditures came to 2.9 billion in May — an increase of 10 percent over the April total and 6 percent above the May 1952 total, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the Department of Commerce. Although most of the April–May rise occurred on private residential construction and roadbuilding, bad weather kept these types of work from increasing as much as usual during May. Total private expenditures for May were up 8 percent from April to almost $2 billion, and public outlays rose 13 percent to $933 million.



Increase of 10 percent in construction expenditures for May to total of $2.9 billion is indicated in Department of Commerce curves.

New construction activity as a whole totaled a record $12.6 billion for the first five months of the year — an increase of almost 6 percent above the 1952 figure for the January–May period. Private construction, with a value of $8.7 billion, accounted for nearly the entire gain over last year, largely from increased outlays for new dwelling units and commercial building. Public expenditures, totaling $3.8 billion, were but slightly above the January–May 1952 total, as reduced activity on public housing, hospitals, and federal reclamation and development work offset the moderate gains for most other types of public construction.

Private spending for residential building reached almost $987 million during May — an advance of nearly 9 percent over April and of 7 percent above the same month a year ago. Despite the rainy spring, total expenditures on private residential building, including motels, hotels, and dormitories, showed significant increases over the year, with outlays of almost $100 million—a 56 percent increase over the first five months of 1952.

May expenditures of $128 million for commercial building were at the highest monthly rate in two years, and the joint agencies forecast an even higher figure for June. More than half a billion dollars was spent during the first five months of 1953 for the construction of new offices, stores, and other types of commercial building, compared with the $387 million spent during the same period in 1952.

Private industrial construction remained strong during the month, with outlays almost equaling the April figure and expenditures above the year-ago level for the first time in eleven months. Highway expenditures advanced almost 50 percent during the month to $250 million, though the total for the first five months of this year ($740 million) was only slightly above outlays for the January–May 1952 period. Following a seasonal rise in May, military and naval expenditures for new construction totaled $530 million for the first five months of 1953 — an increase of about 6 percent over the comparable period last year.

Winners in General Motors Highway Contest Announced

Top national prize of $25,000 in the General Motors contest on "How to Plan and Pay for the Safe and Adequate Highways We Need" was awarded to Robert Moses, construction coordinator of New York City. Second in order of national merit was the entry of Lacey V. Murrow, M. ASCE, executive director, Association of American Railroads, for which he received $10,000. The third award of $5,000 went to Claude A. Rothrock, M. ASCE, state planning engineer, West Virginia State Road Commission. National honorable mention awards of $3,000 each went to William E. Willey, A.M. ASCE, engineer, Division of Economics and Statistics, Arizona State Highway Department; to William F. Steuber, of Madison, Wis.; and to David C. Guilbert, Spokane, Wash. Regional awards also were made in this $190,000 contest.

Mr. Moses recommended strongly that expenditures for our national highways be raised to $5 billion per year for the next 10 years, an amount nearly twice the current expenditure by federal, state and municipal governments for highway construction. This, he said, could be done in part by raising the present $550,000,000 annual federal aid to states for highway construction to $1.1 billion. The money could be raised, according to Mr. Moses, by increasing the federal gasoline tax from 2 to 3 cents per gal; and by raising the national average of state gasoline tax from 4.9 to 5.4 cents per gal. In each case a larger proportion of the gasoline tax, the tax on oil, taxes on trucks, and motor vehicle registration fees should be devoted to new highway construction.

The more than 40,000 entries were judged by a panel of five, composed of Ned H. Dearborn, president of the National Safety Council; Thomas H. MacDonald, Hon. M. ASCE, retired Commissioner of Public Roads; Dr. Robert Sproul, president, University of California; Curtis McGraw, chairman of the board, McGraw-Hill Publishing Co.; and Bertram D. Tallamy, M. ASCE, chairman, New York State Thruway Authority.

Large Hospital Contract Let to New York Firm

Award of a $7,095,000 contract for construction of the new Eastern Pennsylvania Psychiatric Institute to the Turner Construction Co., of New York, is announced by the Pennsylvania General State Authority. To be located in Philadelphia, the project will include a twelve-story main building and a number of appurtenant hospital and administrative structures. The group of buildings will be of concrete fireproof construction with exterior walls of face brick, and will have a structural steel frame.

Structural engineers on the project are Sanders & Thomas, Inc., of Philadelphia, and W. H. Gravell, M. ASCE, of Philadelphia is consulting engineer. Harbeson, Hough, Livingston & Larson are the architects, and Harry Sternfeld the associate architect.

Heavy Extrusion Press Erected in Record Time

The nation's heavy press program has moved another step forward with the recent installation of a 14,000-ton extrusion press—the largest ever erected in this country—at the Lafayette, Ind., plant of the Aluminum Company of America. Erection of the huge press, which was built in Dusseldorf, Germany, was completed in a record four months by F. H. McGraw & Company, equipment erection specialists.

Installed as part of the U. S. Air Force program, the new press is capable of extruding aluminum products nearly four times heavier than those coming from presses now in operation. It takes a billet of 31-in. diameter and, because of its size, can squeeze out larger and more intricate shapes for airplanes. In a wing panel, this will mean a stronger airplane skin with less weight and less riveting. When the press gets into operation the government will have first call on all production under a lease arrangement betweel Alcoa and the U. S. Air Force. In a peacetime economy the press will produce aluminum pipe for the petroleum industry, curtain walls for ultra-modern buildings, and strong alloy shapes for various industries.

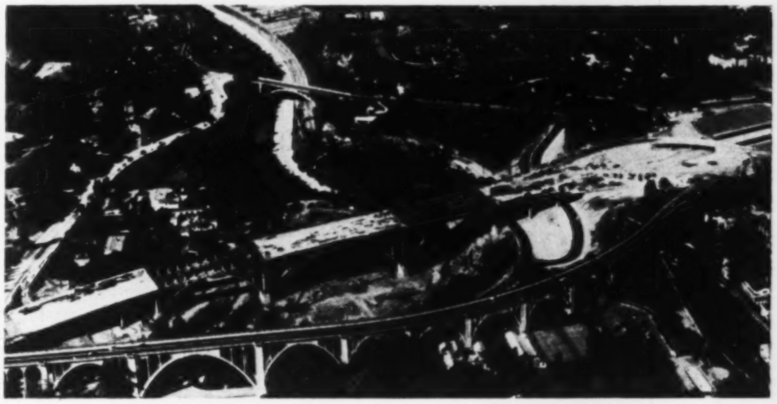
The press castings posed a transportation problem when they were unloaded in New York last summer because of their huge size—they were 23 ft long, 8½ ft wide, and 14 ft high and weighed up to 107 tons. Shipped on five specially built railroad cars, they could not be moved faster than 30 mph and then only during daylight hours.

Fulbright Award Program for 1954–1955 Announced

A new competition for Fulbright Awards for university lecturing and postdoctoral research abroad is announced for the 1954–1955 school year by the Committee on International Exchange of Persons. The research and lecturing programs will be open in Austria, Belgium and Luxembourg, Denmark, Egypt, Finland, France, Germany, Greece, Iraq, Italy, Japan, the Netherlands, Norway, Pakistan, Sweden, and the United Kingdom and its colonial dependencies. Application forms and detailed information are available from the Conference Board of Associated Research Councils, Committee on International Exchange of Persons, 2101 Constitution Avenue, Washington 25, D.C. Applications must be postmarked not later than October 15, 1953.

The present program is specifically for university lecturing and postdoctoral-level research. Graduate students interested in enrolling for courses abroad or for a directed program of study at the predoctoral level should apply directly to the Institute of International Education, 1 East 67th Street, New York City.

Construction Is Pushed on Los Angeles Freeway System



Colorado Freeway Bridge over the Arroyo Seco, joining Pasadena and the Eagle Rock section of Los Angeles, is one of many interesting and beautiful bridges going up as part of the Los Angeles Freeway System. Shown in foreground is the old two-lane Colorado Street Bridge built in 1912 and the new Colorado six-lane freeway bridge under construction. The Guy F. Atkinson Co., which is building the bridge, is also contractor on the adjacent section of freeway extending west to the Los Angeles city limits and east to a connection with Holly Street in Pasadena. Completion of the bridge is expected by December of this year. Photo courtesy "California Highways and Public Works."

Ohio Supreme Court Sustains Commission's Right to Specify Pavement

The right of the Ohio Turnpike Commission to specify portland cement concrete has been established by a 7–0 decision of the Ohio State Supreme Court. In so ruling, the Court stated that:

"1. Neither Section 1205 nor any other section of the Ohio Turnpike Act which comprises Sections 1201 to 1222, inclusive, General Code, imposes upon the Ohio Turnpike Commission the duty, in the exercise of its discretion, to prepare designs, plans and specifications for a highway, which is to be constructed by it, of alternative materials or to procure bids on construction of such highway of alternative materials.

"2. The Ohio Turnpike Act invests the Ohio Turnpike Commission with discretion, if acting in good faith, to determine the design, plans and specifications for a highway to be constructed by it and to determine the material of which such highway is to be constructed.

"3. Mandamus will not lie to compel the Ohio Turnpike Commission to procure bids for the construction of a highway of alternative materials."

The same issue was raised when R. H. Shafer, president of the Ohio Road Improvement Co., which operates six asphalt plants along the route of the Turnpike, brought suit challenging the Commission's decision to use a rigid pavement design. The Court of Appeals concurring with the report of its referee, ordered that the Commission ". . . provide plans and specifications for the receipt of bids upon comparable designs of asphaltic concrete as well as Portland cement concrete." This judgment of the Court of Appeals has now been reversed.

In arriving at its decision the Supreme Court stated that:

"The worst that the referee could say was that the chief engineer was prejudiced in favor of cement paving. We are not impressed by that conclusion. The chief engineer had had many years experience in the construction of highways and it is but natural that he should have formulated some convictions as to the relative merits of the many materials out of which such a highway could be constructed. . . . Furthermore, the commission is not bound to adopt a type of construction and to use a particular material merely because such construction would be less expensive than some other type of construction. Cost alone is not controlling. The commission would be remiss in its duties if it adopted a cheaper type of construction notwithstanding its judgment that a more expensive type would be worth its cost and would better serve the intended purpose."

"No bad faith having been shown, the court cannot substitute its judgment for that of the commission. This would be true even though the commission may have erred in judgment. Error of judgment does not invalidate discretion, exercised in good faith."

Diverse Program Presented at 67th Annual Meeting of EIC

Prestressed and precast concrete construction, nuclear radiation as a factor in building design, the development of atomic energy in Canada, economy through standardization, the Halifax-Dartmouth Bridge, the mechanization of mining, marine aspects of cathodic protection, the role of management in the social and technical sciences—these were some of the subjects presented at the 67th annual meeting of the Engineering Institute of Canada in a program of papers and panel discussions notable for its scope. The three-day meeting (May 20–22) was held at Dalhousie University, Halifax, N.S.

As in other recent technical meetings, emphasis was placed on papers on prestressed and precast concrete construction. In one of these, A. L. van den Brandeler, of the British Columbia International Engineering Co., Vancouver, described the first prestressed concrete bridge built in Canada—a span over Mosquito Creek in North Vancouver. He forecast "a great future for the new technique, in spite of the heavy cost of labor in this part of the world." In another major paper, use of precast concrete was called the logical method of carrying out an extensive program of small bridge construction that must be undertaken in the Province of Alberta, by L. G. Grimble, J.M. ASCE, chief bridge engineer of the Alberta Department of Highways, and R. N. McManus, associate professor of civil engineering at the University of Alberta. Construction of the prestressed concrete grandstand at the Sherbrooke, Quebec, Baseball Stadium was discussed by G. M. Demarque, chief engineer for the Preload Company of Canada, Ltd., Montreal. Mr. Demarque said that prestressing permitted a 35 percent saving in steel as compared with grandstands constructed by other methods.

The attendance of over 700 included ASCE President Walter L. Huber and Executive Secretary William N. Carey, as well as the secretaries of most of the other EJC societies. Secretary Carey was the principal speaker at a luncheon meeting of the Commercial Club of Halifax, one of several organizations meeting during the three-day EIC program. Speaking on the subject, "Atoms and Engineers," Secretary Carey hailed "the demonstration ten years ago of a way to release and control atomic energy as the discovery of a new world," with a composite of scientists and engineers, "another Columbus." Indicative of the new world in which we live, he said, is the fact that the Atomic Energy Commission is today the third largest business in the nation. To meet the challenge of developing this new era, "in which engineers and scientists will be of greater importance than ever before," Secretary Carey urged "a review and reorientation of some of our educational processes in engineering."

Culminating feature of the three-day program was the annual banquet on May 22. Sir Robert Watson-Watt, who is called the "father of modern radar," was guest speaker. He is president of Adalia Limited, Montreal. In the presentation of awards and medals, a traditional feature of the annual banquet, two ASCE members living in Montreal were awarded honorary membership in the EIC. They are Arthur Surveyer, who is also an Honorary Member of ASCE, and F. P. Shearwood. Others receiving honorary membership were Alex J. Grant, of Montreal; A. L. Killaly, of Peterborough, Ontario; and Stewart Young, of Regina, Saskatchewan. Among the winners of awards and medals was James A. Vance, of Woodstock, Ontario, who received the Sir John Kennedy Medal in "recognition of outstanding merit in the profession and noteworthy contribution to the science of engineering and to the Institute." J. S. Kendrick, A.M. ASCE, of Montreal, was co-winner, with F. L. Lawton, of the Ross Medal "for papers on electrical engineering subjects."

At the close of the banquet Ross L. Dobbin, of Peterborough, was inducted into the presidency of EIC, succeeding J. B. Stirling, M. ASCE, of Montreal. New vice-presidents are I. M. Fraser, G. R. Henderson, and I. R. Tait.

Early Construction for The Dalles Dam and Powerhouse

Excavation is now well under way for The Dalles Dam and Powerhouse, located on the Columbia River between Bonneville and McNary dams. Representing the fourth stage of the Army Corps of Engineers development of the river for navigation at The Dalles, Oreg., the project will also be important from the power standpoint and will house the world's most powerful adjustable-blade-propeller turbines. Each of the fourteen initial turbines being manufactured by the Baldwin-Lima-Hamilton Corp., Philadelphia, is rated at 123,800 hp at 85.7 rpm and 81-ft head, and will drive a 78,000-kw generator. Started in March 1952, the first power units will be placed in service in November 1957, and all fourteen are expected to be in operation by 1960.

Lumber Research Program Started

A $1,000,000 research program designed to cut home-building costs and give consumers new and better lumber products has been launched by the nation's lumber industry, according to an announcement from the National Lumber Manufacturers Association. Putting major emphasis on lamination, the program will involve a total outlay of $1,100,000 over a ten-year period, to be financed by individual lumbermen and lumber companies. It will be set up by the Products and Research Committee of the N.L.M.A., and the lamination research will be conducted by the Timber Engineering Co., an affiliate of the organization.

End products the program is expected to develop include glued-up lumber panels faced with veneer and heavy-duty paper or thin fiberboard. Some of the panels may require no facing. "Indications are that builders could effect worth while economies by using these lumber panels for exterior wall and roof sheathing, sub-flooring and interior partitions," according to Leo V. Bodine, executive vice-president of the N.L.M.A. "The panels could be made of low-grade lumber without sacrificing quality or performance—a fact which in itself should save the builder money."

Financing Arranged for Delaware River Crossing

A second bridge over the Delaware River at Philadelphia will be built, following recent arrangements for financing made by the Delaware River Port Authority. The Authority, an agency of the states of Pennsylvania and New Jersey set up in 1951 to succeed the Delaware River Joint Commission, has sold a $100,000,000 issue of toll revenue bonds to a syndicate of 303 investment houses. The interest rate is 3.435 percent. Of the amount borrowed, $90,000,000 will be used for building the bridge and approach highways, and the remainder applied toward the Authority's outstanding debt in connection with the present bridge between Philadelphia and Camden.

The proposed seven-lane suspension span will be built about three miles south of the Camden bridge, and will connect Philadelphia (at Packer Avenue) with Gloucester, N.J. Completion of construction is scheduled for 1957.

Army Awards Defense Contracts in Alaska

Announcement that the $12,328,224 Army Indoctrination School project at Big Delta, Alaska, has been awarded two joint venturers—Peter Kiewit & Sons Co., of Omaha, Nebr., and Fred J. Early, a Salinas, Calif., firm—has been made by the Alaska District Engineer.

Also announced were two other contract awards and the results of a bid opening. The Morrison-Knudsen Co., of Boise, Idaho, has been awarded a $1,432,292 contract for construction of two warehouses at Elmendorf Air Force Base, and the Seattle, Wash., firm of S.S. Mullen, Inc., has received a contract for a 40,000-sq ft warehouse, to be located at Ladd Air Force Base, on their bid of $450,139. Lytle, Green & Birch, of Seattle, was apparent low bidder, at $4,229,268, on two combined proposals to construct family housing at Ladd Air Force Base.

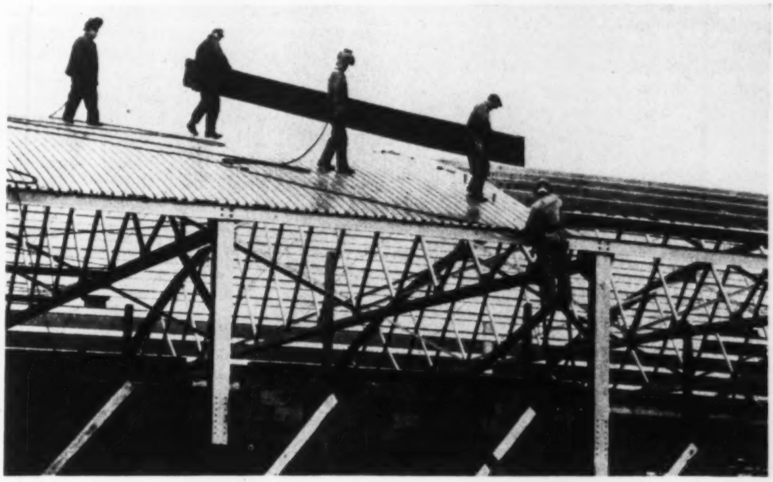
Chief Joseph Dam Nears Completion

After three years of construction, Chief Joseph Dam on the Columbia River in Washington is better than 80 percent completed. Its hydroelectric powerhouse when completed will have a capacity of 1,800,000 kw, second in generating capacity only to the 2,000,000-kw plant at Grand Coulee Dam 50 miles upstream. The first three 67,000-kw generators are expected to go on the line in 1955. Construction engineer for the Corps of Engineers is C. H. Wagner, M. ASCE.

Guyed Steel Mast of Light Weight Supports Flare Stack

A flare stack of unusual type has been erected at the Llandarcy, Wales, oil refinery of the Anglo-Iranian Oil Co., Ltd. The 250-ft-high 2-ft-dia stack—one of five erected at the company's three major refineries in the United Kingdom—is used to burn off waste gases from the catalytic cracking plant, the gas being ignited at the top of the stack by a constantly burning pilot flare. It is supported by a guyed steel lattice mast 235 ft high, believed to be the first of its kind to be used in the oil industry. The lattice mast required only two-thirds the steel of a comparable self-supporting structure and is more easily supported on the marshy sites involved. Designed to withstand a wind of 75 mph, the lattice mast has a total weight of 21 tons. The stays are attached at the 174-ft level, with the ground ends secured to concrete anchorages through length-adjusting devices. At its base the mast rests on a rocker bearing to afford free angular movement. British Insulated Callender's Construction Co. Ltd., designed, supplied and erected all five masts.

Steel Roof Deck Tops Expedite Industrial Building



Saving of time and money in industrial roof building is possible with use of steel roof decking, pre-formed and pre-cut to exact roof size and contour. This type of construction is currently being used (see photo) on last of six building units, with bowstring truss roof construction, in Pelham Manor, N.Y., started about 20 months ago to house facilities of several different manufacturers. To roof the new steel-frame, masonry-wall buildings, the builder (Rusciano & Son Corp.) is using 242,000 sq ft of Tri-Rib steel deck, furnished by the Wheeling Corrugating Co., Wheeling, W. Va. The Tri-Rib panels for the bowstring roofs arrive at the construction site pre-curved to a radius of 138 ft 11 in., and varying in length from 20 to 22 $^{1}/_{2}$ ft. Though each panel is 18 in. wide and covers about 30 sq ft, it weighs only 67 lb. Easily handled by one man when necessary, the panels are quickly placed. A four-man crew, consisting of two welders and two erectors, can lay 4,000 sq ft of the steel deck in one day. A finish coat of aluminum paint applied to the under side of each panel before it is welded in place serves as the interior ceiling color.

New Steel Mill Starts Operation in Kentucky

A \$40,000,000 hot strip mill was officially placed in service late in May at the Armco Steel Corporation's Ashland, Ky., plant, where both the oldest and the newest continuous steel rolling mills are located.

Thirty years ago Armco developed the continuous rolling process at its Ashland plant, and the basic facilities of the original mill are still in operation there. The new 80-in. mill, which has been under construction for more than two years, is the most modern of its kind in the world. It can roll ten-ton steel ingots into thin strips of steel hundreds of feet long in a continuous process. The mill is housed in a building almost half a mile long and has a capacity of 150,000 tons of finished steel a month — enough for 133,000 new automobiles.

The company's overall expansion program at Ashland will cost \$47,000,000. Though the major part of the program is now completed, construction is continuing on facilities for processing light-gage steel.

California Firm Opens Office in Washington

To handle its expanding activities in the East, the engineering and construction firm of Holmes & Narver, with home offices in Los Angeles, has opened an Eastern office in Washington, D.C. The establishment of the new branch office follows by four years the opening of an office in Honolulu to handle some of the firm's overseas projects. Both branch offices are unaffiliated ventures, dealing exclusively with Holmes & Narver project representation and client service.

The Washington office will be under the management of Stanley H. Wright, M.ASCE whose 30-year record in the engineering management field includes experience as head of the War Projects Unit of the Bureau of the Budget and in various capacities for the Construction Engineering Division of the Atomic Energy Commission in Washington.

Holmes & Narver is currently engineering the initial \$16,000,000 unit of the Anheuser-Busch West Coast plant, which will ultimately cost \$45,000,000.

U.S. Steel to Build New Plant in Ohio

To meet the growing demand for iron among the iron and steel foundries in the Cleveland area, the American Steel & Wire Division of the United States Steel Corp. has broken ground for a new blast furnace for production of merchant pig iron at its Central Furnaces & Dock plant in Cleveland. The new unit, which will be known as "A" furnace will be 106 ft high and will turn out about 1,350 tons of pig iron a day. Modern equipment for eliminating air and water pollution is provided for in the design of the furnace, and the millions of gallons of water used in cooling the furnace and washing the gas will be returned to the Cuyahoga River cleaner than when they were taken out.

The ground-breaking ceremonies were held in the shadow of "B-2" furnace, which rests on the foundations of the first blast furnace built in the Cuyahoga Valley. About fourteen months will be required for building the new unit and integrating it with the other facilities in the plant.

N. G. Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"What do you know, Joe?" asked Professor Neare.

"I know I miscopied your problem of the 3 snow plows clearing the road around Lake Mixihaxiwunxit," confessed Joe Kerr. "The way I had it, the Sno-Glo had to glow at noon and the $^2/_3$-power Sno-Shovo at 1:00 p.m., so if it started to snow before 10:30 a.m., the power ratio would exceed the accumulated-snow ratio and Sno-Shovo would catch up in time. But the $^1/_2$-power Sno-Pusho starting at 2:00 p.m. with less power and just as much snow could never catch Sno-Shovo, so maybe I mistook the time."

"A likely story," scoffed Cal Klater. "Why Joe drew a B+ in Descrip by being the best copier at the U; he practically majored in Copyology. He even . . ."

"Hush," warned Joe, "or I'll tell why Zasa calls you . . ."

"All right, but I'll show how simple a problem called your bluff. First let's call the 3 plows X, Y and Z and let x, y and z, respectively, be the elapsed times after the snow started that the plows passed any point S distant s from the starting point. Then if the snow started a hr before noon, when $s = 0$, $x = a$, $y = a + 1$ and $z = a + 2$.

"Since no unit was given for distance, let's measure s by the stretch of 1-hr snow Sno-Glo can clear in an hour, so that

$$\frac{dx}{ds} = x \quad . \; . \; . \; . \; . \; . \quad (1)$$

Proportionately, $y - x$ is the measure of snowfall at S between treks of X and Y, so, considering the power ratio,

$$\frac{2dy}{3ds} = y - x \quad . \; . \; . \; . \; . \quad (2)$$

and similarly

$$\frac{dz}{2ds} = z - y \quad . \; . \; . \; . \quad (3)$$

Solving (1) for x and substituting in (2), and so on, involves the exponential $e^{0.5s}$, which can be represented by b. I found

$$x = ab^2 \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (4)$$

$$y = 3ab^2 - b^3(2a - 1) \quad . \; . \; . \; . \; . \; . \; . \quad (5)$$

$$z = 6ab^2 - 4b^3(2a - 1) + b^4(3a - 2) \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (6)$$

Equating these for the final coincidence, I found $a = {}^3/_4$, $b = 3$ and $x = y = z = 6.75$. That is, snow fell for 6.75 hr from 11:15 a.m. until 6:00 p.m."

"Exactly," beamed the Professor, "which is surprizing because most snowplow problems have logarithmic answers. Joe wasn't too illogical in his skepticism, either, for the two smaller plows lagged at first. At one point ($b = 2$) Sno-Shovo had lost an hour, this being the maximum lag. At the finale, both little plows were shoveling no snow impossibly fast.

"Now, as Guest Professor again, Stoop Nagle has a little problem you can do on your vacation, without book or slipstick."

"But a sharp pencil, Noah. This problem developed from new discoveries at the Deltopolis Dig, proving that the Deltonians were able geometers who abhorred the right angle as much as they worshipped the triangle and the number 7. The sketch of the division of their market place by low walls bounding 7 stalls appeared random at first, but surveys showed that prolongations (dotted) of 3 walls intercepted outer walls at third points. Lengths of outer walls were 13, 14 and 15 dels respectively, making the area of each stall an integer. Which was the largest?"

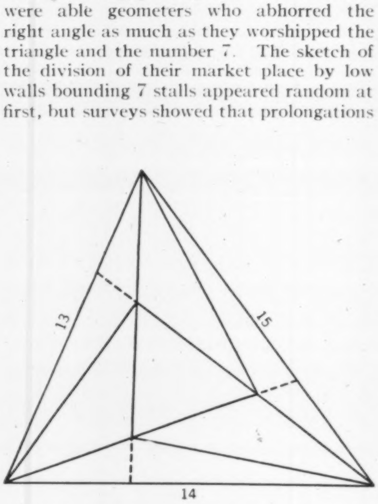


FIG. 1. The seven deltoid stalls of a Deltopolitan market place.

[Cal Klaters were: R. E. Philleo, Flo Ridan (Charles G. Edson), Rudolph W. Meyer, Stoop (John L.) Nagle (the Guest Professor), Sauer Doe (Marvin Larson), and John R. Stephens.]

Underground activity won't sabotage THIS sewer

PIPE THAT TREADS WATER. Here is a close-up of the Armco watertight joint. Note the four bolted rods that say "no" to seepage.

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ARMCO SEWER STRUCTURES

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DECEASED

Frederick Webber Amadon (A.M. '14), age 69, former engineer with the Interstate Commerce Commission, Washington, D.C., died at Arlington, Va., on May 4. Connected with the Commission from 1916 until his retirement in 1951, Mr. Amadon was senior civil engineer in the Bureau of Valuation from 1919 to 1939, and associate engineer in the Bureau of Motor Vehicles from 1940 on. He studied at the Massachusetts Institute of Technology.

Frederic Bass (M. '11), age 77, who retired in 1943 as head of the department of civil engineering at the University of Minnesota, died in Minneapolis, Minn., on May 13. Shortly after graduating from the Massachusetts Institute of Technology in 1901, Professor Bass joined the faculty of the University of Minnesota, advancing to the chairmanship of the civil engineering department in 1918. He served as consulting engineer on sanitation and sewage projects in a number of Minnesota municipalities, and was president of the Minnesota State Board of Health for several years.

William Charles Benson, Jr. (J.M. '43), age 31, designer and draftsman for the Buell Engineering Co., Inc., New York, N.Y., died in East Orange, N.J., on May 24. Mr. Benson joined the Buell organization in 1946, after three years as a plant layout engineer for the Bendix Aviation Co. He was an alumnus of the Newark College of Engineering.

Herman Matthew Braloff (M. '33), age 55, since 1933 secretary-treasurer of the Cauldwell-Wingate Co., and vice-president of the Brader Construction Co., New York, N.Y., died at Rockville Center, N.Y., on April 24. Prior to his association with these firms, Mr. Braloff was treasurer of the Corson Construction Corp., and assistant engineer of the Rosenthal Engineering Contracting Co., both of New York City. He was an alumnus of New York University.

Montgomery Babcock Case (M. '16), age 71, consulting engineer of Englewood, N.J., died there on May 7. A 1906 graduate of the University of Illinois, Mr. Case was employed early in his career by Ralph Modjeski on the design and construction of bridges. He was engineer in charge of construction of such structures as the Philadelphia-Camden Bridge and the George Washington Bridge.

Louis Moses Chokla (A.M. '25), age 72, who organized the Russian department of Southern Methodist University at Dallas, Tex., in 1941, and directed it until his retirement ten years later, died on June 1 in East Rockaway, N.Y., where he had recently been residing. After graduating from the University of Texas, Mr. Chokla engaged in private practice for nearly 30 years, with headquarters at Austin and later at Dallas.

Robert Wetmore Collins (M. '42), age 57, president of the Southwestern Construction Co., Houston, Tex., and an alumnus of the University of Michigan, died in September 1952. Associated with the Southwestern Construction Co., from 1923 on, Mr. Collins advanced from manager to vice-president in 1926 and was named president in 1932. He was a veteran of World War I.

Otto Vere Hough (A.M. '23), age 64, since 1948 president of Hough, Cowgur & Co., Inc., St. Louis, Mo., died on June 6. He was an alumnus of the University of Nebraska. Connected with the Woods Brothers Construction Co., of Lincoln, Nebr., from 1920 until 1948, Mr. Hough served as manager and superintendent at their offices in Lincoln, Kansas City and St. Louis, Mo.

Myron Vincent Judd (A.M. '50), age 56, for the past five years associate and field engineer with the engineering firm of Parker, Hill & Ingman, Seattle, Wash., died at his home in that city on November 1. Following 13 years in the investment field, Mr. Judd engaged in private practice in Canada, Alaska and several western states, worked for the U.S. Coast and Geodetic Survey, and served as a project engineer on an aerial survey of King County, Wash. He was an alumnus of the University of Washington and Columbia University.

Ray Harrison Lindgren (M. '41), age 58, since 1935 treasurer of Crandall Dry Dock Engineers, Inc., of Cambridge, Mass., and member of the firm for 35 years, died on April 13. Mr. Lindgren was briefly employed as a draftsman by the American Bridge Co., and the Lackawanna Bridge Co., before entering the Crandall firm as a designer. He studied at the University of Maine and the Massachusetts Institute of Technology.

Edward Eastman Minor (M. '08), age 76, retired vice-president of the Milford Water Company and the New Haven Water Company, died in New Haven, Conn., on May 14. Appointed vice-president and director of both organizations in 1937, Mr. Minor was serving them in an advisory capacity as director at the time of his death. His association with the New Haven company began in 1910 and with the Milford company in 1916. Mr. Minor was a graduate of the Sheffield Scientific School.

John Strother Moore (M. '41), age 66, field engineer with the U.S. Bureau of Reclamation, serving as superintendent of the Minidoka project in southeastern Idaho at the time of his retirement in 1950, died in Yakima, Wash., April 28. A graduate of Washington and Lee University, Mr. Moore joined the Bureau of Reclamation in 1908. He had been superintendent of the Yakima project and director of operations at Denver, Colo., in 1941.

Harrie Langdon Muchemore (A.M. '15), age 69, who retired in 1950 as construction engineer for the Turner Construction Co., of New York City, died at Sanford, Fla., on March 26. Mr. Muchemore, who joined the firm in 1931, had served as chief engineer at Pearl Harbor, and on construction of 93 fleet tankers for the Alabama Drydock and Shipbuilding Co. In 1943 he was awarded the U.S. Navy Meritorious Civilian Service Award for valuable contributions to the war effort. He graduated from the Thayer School of Civil Engineering at Dartmouth College.

Francis Barnard O'Connor (A.M. '19), age 61, president of the Alphons Custodis Chimney Construction Co., New York, N.Y., died in that city on May 26. Mr. O'Connor had been with the firm since his graduation from Cornell University in 1913—as construction engineer from 1919 to 1935, and as president of the firm from the latter year on.

Howard Norman Old (M. '46), age 62, sanitary engineer director for the U.S. Pub-

Please supply all information requested before September 30, 1953.

FOR ASCE MEMBERSHIP DIRECTORY

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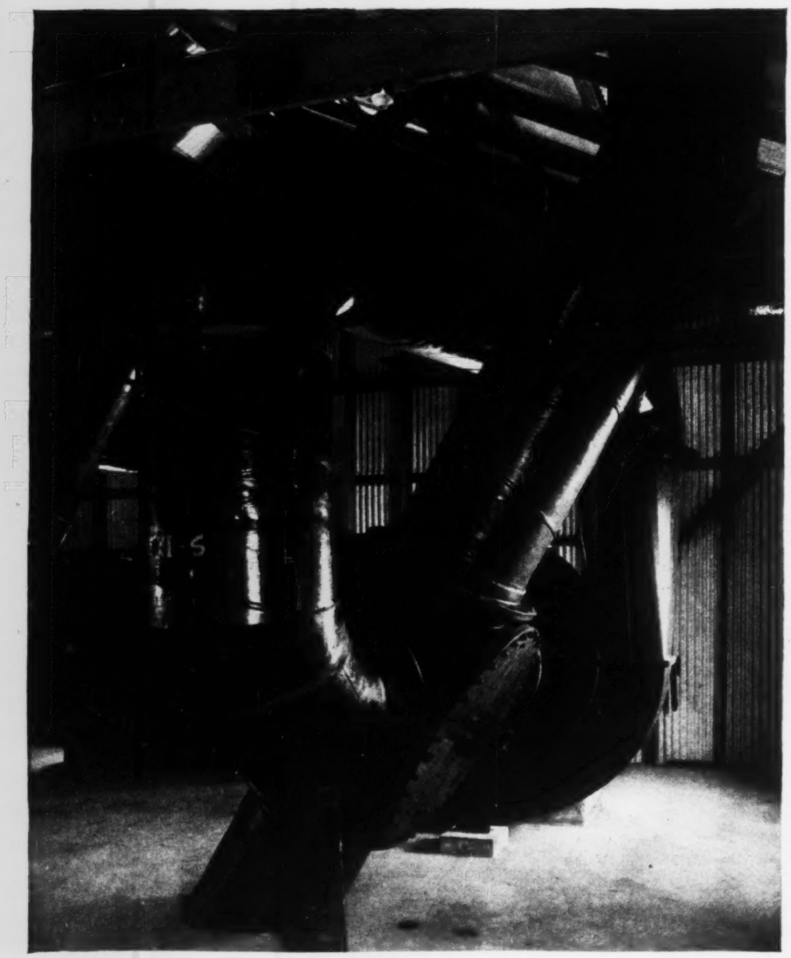

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lic Health Service, Washington, D.C., died in Baltimore, Md., on May 7. Connected with the Health Service continuously for 35 years, Mr. Old had had headquarters in Manhattan, Kans., Memphis, Tenn., Baltimore, Md., and Washington, D.C. In 1945 he was promoted to sanitary engineer director in charge of the Land and Air Carrier Section of the Sanitary Engineering Division.

Robert Youngman Patterson (M. '14), age 72, vice-president in charge of engineering and drainage for the United States Sugar Corp., and its predecessor, the Southern Sugar Co., for 25 years, died in Pensacola, Fla., in May. He had been chief engineer of the Gulf, Florida & Alabama Railway Construction Co., and vice-president of Wills & Sons & McCarthy Construction Co., drainage contractors of West Palm Beach, Fla. Mr. Patterson had participated in construction of the Lake Worth, Baldwin, Iona, and Bunnell drainage districts.

John Charles Pritchard (M. '26), age 72, consulting engineer of Magnolia, Miss., died in June 1952. Engaged in the St. Louis municipal service for many years, Mr. Pritchard was with the water department from 1909 to 1919 and 1923 to 1926, and served as director of public utilities from 1926 to 1933. From 1929 to 1941 he was treasurer and vice-president of Russell & Axon, St. Louis consulting engineers. He was a graduate of Washington University.

Frank Oliver Ray (A.M. '15), age 81, city engineer for Colorado Springs, Colo., from 1921 to 1950, and since then consulting engineer in the City Engineering Department, died on May 14. Earlier he was with the Colorado Fuel & Iron, Co., Pueblo, Colo., and engaged in private practice for a brief period. He was a graduate of the University of Missouri, class of 1892.

Henry Frederick Schlueter (J.M. '49), age 25, first lieutenant, U.S. Marine Corps Reserve, was killed in action in the Korean area on March 24. After receiving a degree in civil engineering from the University of Nebraska in 1949, Mr. Schleuter was employed for a brief period as junior bridge engineer with the Nebraska State Bridge Department, at Lincoln.

Vernon Keller Senour (J.M. '49), age 33, architectural draftsman with Alves D. O'Keefe, of Plymouth, Ind., was killed in an automobile accident in Plymouth, on January 9. Earlier Mr. Senour was employed in a similar capacity by Maurer & Maurer, architects and engineers, of South Bend, Ind. He graduated from the University of Illinois in 1949 with a bachelor of science degree in architectural engineering.

Robert Lincoln Elwyn Ward (A.M. '27), age 61, civil engineer with the Corps of Engineers in the Seattle (Wash.) District, died in Seattle on November 24, 1952. He was an alumnus of Western Reserve University. For 15 years (1929–1944) Mr. Ward was with the Corps at New Orleans, Pittsburgh, Boston, Providence, Sacramento, Bonneville and Portland, Oreg., and Costa Rica. In 1951, he returned to the Corps after several years with the Aero-jet Engineering Corp., Pasadena, and the U.S. Bureau of Reclamation at Coulee Dam.

Albert James Wegmann (J.M. '50), age 25, a 1950 graduate of the Drexel Institute of Technology, died on May 11. Mr. Wegmann had been employed briefly as a structural engineer-draftsman with the American Bridge Co., at Ambridge, Pa., and as a bridge draftsman with the Baltimore & Ohio Railroad in Baltimore, Md.

Theodore Calvin Tuck (M. '52), age 74, partner in the firm of Tuck and Eipel, consulting engineers of New York City, died on May 21. Before establishing his own practice in 1939, Mr. Tuck was engineer in charge of the New York construction firm of Post and McCord for more than 35 years. He was an alumnus of the Massachusetts Institute of Technology, class of 1900.

NEWS OF ENGINEERS

Robert W. Abbett, partner in the New York City firm of Knappen-Tippetts-Abbett-McCarthy, received an honorary degree of doctor of science from Gettysburg College on June 7.

Clarence E. Boesch, since 1937 chief civilian engineer and principal assistant to the North Atlantic Division Engineer, Corps of Engineers, New York, retired recently after 48 years of private and public engineering work. Mr. Boesch has directed the planning of Mississippi River dikes and revetments at Memphis, work on the Atlantic-Gulf Ship Canal, and the design of water works for Chicago.

William J. Farrisee, dean of students at the Clarkson College of Technology, has been appointed associate dean and professor of civil engineering at Stevens Institute of Technology, and will assume his new duties some time this summer. A graduate of the Massachusetts Institute of Technology, Dean Farrisee, taught for a year at the University of Illinois, before joining the Clarkson faculty in 1922. He has served on the staffs of the summer engineering camps at Yale, Syracuse, and Stevens.

William J. Farrisee

James K. Carr, for the past two years engineering consultant for the Committee on Interior and Insular Affairs of the House

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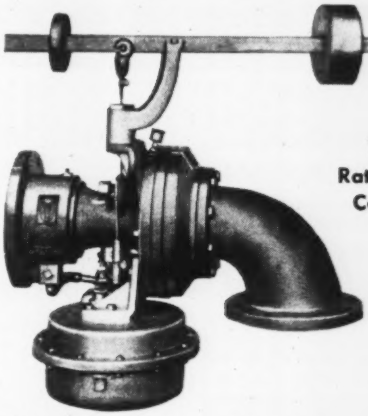

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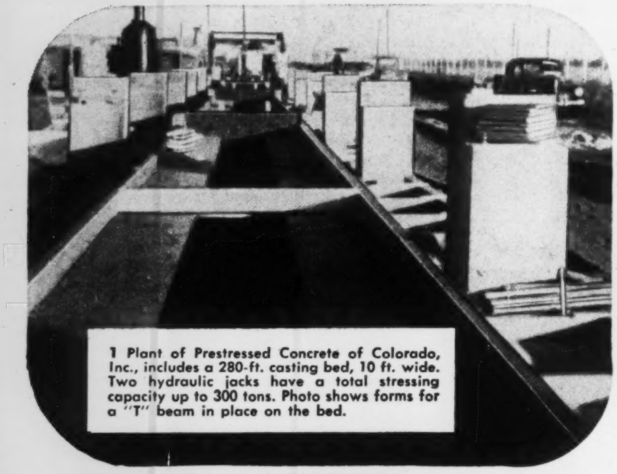
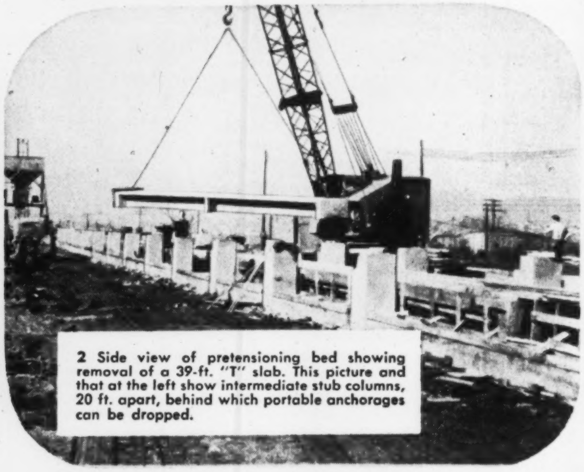
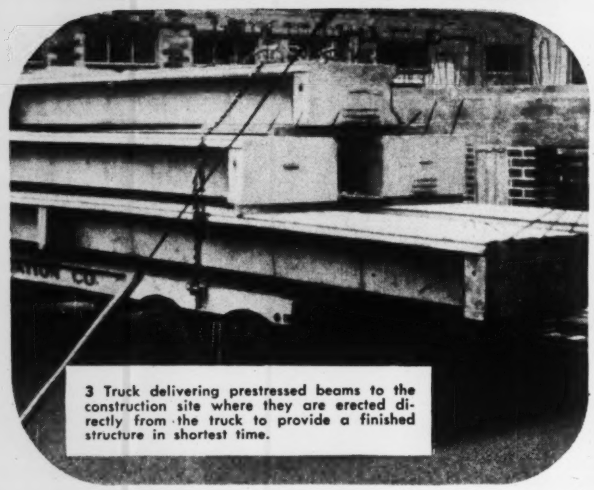


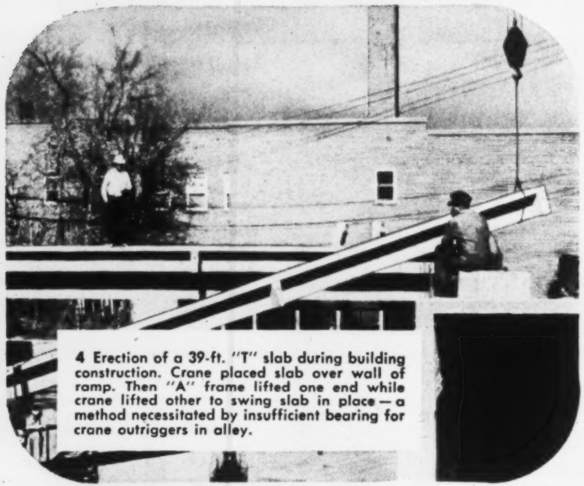
1 Plant of Prestressed Concrete of Colorado, Inc., includes a 280-ft. casting bed, 10 ft. wide. Two hydraulic jacks have a total stressing capacity up to 300 tons. Photo shows forms for a "T" beam in place on the bed.



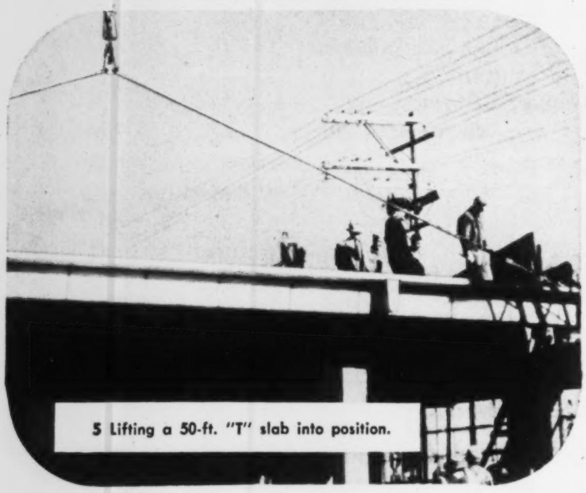
2 Side view of pretensioning bed showing removal of a 39-ft. "T" slab. This picture and that at the left show intermediate stub columns, 20 ft. apart, behind which portable anchorages can be dropped.



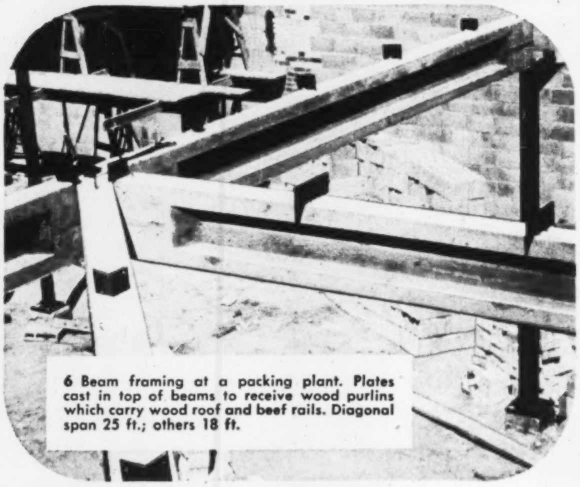
3 Truck delivering prestressed beams to the construction site where they are erected directly from the truck to provide a finished structure in shortest time.



4 Erection of a 39-ft. "T" slab during building construction. Crane placed slab over wall of ramp. Then "A" frame lifted one end while crane lifted other to swing slab in place—a method necessitated by insufficient bearing for crane outriggers in alley.



5 Lifting a 50-ft. "T" slab into position.



6 Beam framing at a packing plant. Plates cast in top of beams to receive wood purlins which carry wood roof and beef rails. Diagonal span 25 ft.; others 18 ft.

PRODUCTION LINE!

Single plant quickly reached daily volume of 1120 ft. of structural members to meet demand

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By June 1, 1953 Prestressed Concrete of Colorado had supplied 130,347 sq. ft. of 100% prestressed concrete roof plus beams to support an additional 25,700 sq. ft. of wood and lightweight slab.

Both casting beds were designed by Phillips-Carter-Osborn, Inc., of Denver, after consultation with Roebling. Six different architectural firms in the area have employed them to design the prestressed concrete members for many structures including the three illustrated on these pages.

• • •

Roebling has pioneered in adapting the principles of prestressed concrete to American practices. Roebling is a major supplier of strand for pretensioning—in Regular and SR (stress-relieved) grades—and of end fittings and strand for post-tensioning.

Based on its experience in this field, Roebling can furnish data and suggestions on the design and operation of plants for fabricating prestressed concrete structural members. Inquiries will be welcome from everyone interested in building such plants and in capitalizing on the most revolutionary and profitable trend since structural steel came into the picture. Prestressed concrete compares favorably with steel cost-wise, and its unique advantages assure a practically unlimited future.

Architects, engineers and builders are invited to write for the Roebling prestressed concrete story.

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7 Placing a double "T" slab during erection of a cold storage plant. Average placement time was three minutes per slab.

8 Same as above. Top view of slabs in place before the lifting hooks were burned off.

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Gathering at the Waterways Experiment Station, Vicksburg, for its 15th meeting is the Committee on Tidal Hydraulics of the Corps of Engineers. Shown (first row, left to right) are members, consultants and guests of the committee: W. C. Cassidy, South Pacific Division; J. R. Johnston, North Atlantic Division; R. O. Eaton, Beach Erosion Board; R. E. Hickson, North Pacific Division; E. A. Schultz, Charleston District; J. B. Tiffany, recorder, Waterways Experiment Station; C. F. Wicker, chairman, Philadelphia District; Col. W. Krueger, Philadelphia District; and Col. C. H. Dunn, director, Waterways Experiment Station. Shown in second row (left to right), G. B. Fenwick, Waterways Experiment Station; J. A. Stirton, San Francisco District; J. H. Douma, Office, Chief of Engineers; C. P. Lindner, South Atlantic Division; Dr. H. A. Einstein, University of California; Dr. G. H. Keulegan, National Bureau of Standards; A. B. Smith, Mississippi River Commission; and H. B. Simmons, Waterways Experiment Station. In the third row (standing in usual order), E. P. Fortson, Waterways Experiment Station; Dr. M. A. Mason, George Washington University; R. F. Rhodes, Savannah, Ga.; H. W. Feldt, Southwestern Division; and E. J. Williams, Mississippi River Commission.

of Representatives, has been appointed consulting engineer for the Sacramento Municipal Utility District. He is remaining in Washington on temporary assignment for the District.

Edwin S. Cullings, chief engineer of the Black River Regulating District, was recently awarded a certificate of recognition for 33 years of service to the community of Watertown, N.Y. The certificate was presented at a dinner held under the auspices of the Jefferson-Lewis chapter of the New York State Society of Professional Engineers.

T. Carr Forrest, Jr., member of the firm of Forrest & Cotton, Dallas, Tex., and past-president of the Texas Section (1951–1952), was installed as the fifteenth president of the National Society of Professional Engineers at its recent annual meeting in Daytona Beach, Fla. During the meeting **Charles F. Kettering,** Hon. M. ASCE, and vice-president of General Motors, received the NSPE award.

L. D. Draper has retired as works engineer at the Bethlehem (Pa.) plant of the Bethlehem Steel Co., after 27 years of service.

John P. Gnaedinger and **Carl A. Metz** announce the removal of their firm, Soil Testing Services, Inc., to a larger office located at 3529 North Cicero Avenue, Chicago 41, Ill.

Karl R. Kennison was recently honored at the New York City Board of Water Supply's 38th annual dinner to the Chief Engineer, held at Fraunces Tavern, New York. Former chief engineer of the Metropolitan District Water Supply Commission, Boston, Mass., Mr. Kennison has now headed the New York system for a year. **Stanley M. Dore,** formerly deputy chief engineer for the Allegheny County Sanitary Authority, Pittsburgh, Pa., is new deputy chief engineer of the design department.

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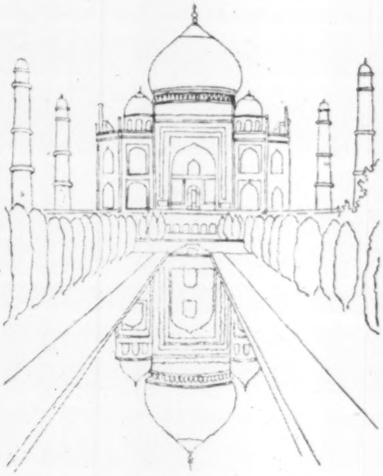
Why the Taj Mahal's designing engineer almost lost his neck!



After completing extensive fill at the site, but before the main construction was started, the engineer disappeared. The Mogul Emperor, Shah Jahan, became so angered he threatened to cut off the head of his engineer as soon as he was found. Six months later the engineer walked into the Shah's palace and stated that he had been in hiding until the fill had settled and the marble mausoleum could be built on a firm foundation. He was forgiven, and the Taj Mahal was then constructed.

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Benjamin F. Fairless, chairman of the United States Steel Corp., and **Ben Moreell,** Hon. M. ASCE, chairman of the Jones and Laughlin Steel Corp., were elected vice-presidents of the American Iron and Steel Institute at the annual meeting of the board of directors on May 27. Mr. Fairless was awarded the honorary degree of doctor of laws by Knox College on June 8.

Russell C. Hertzler, Jr., was recently designated manager of the Milwaukee office of Ammann & Whitney. Mr. Hertzler, former executive highway engineer for Capitol Engineering Associates, of Rochester, N.Y., has had 20 years of experience in all phases of highway design and construction.

Eivind Hognestad, former research associate professor in the department of theoretical and applied mechanics at the University of Illinois, has been appointed to the staff of the Research and Development Division of the Portland Cement Association. Dr. Hognestad will act as manager of the structural development section.

G. Donald Kennedy, vice-president of the Portland Cement Association, Chicago, Ill., was elected executive vice-president at the association's spring meeting in New York City, May 18–20. Mr. Kennedy joined the organization in 1950 as consulting engineer and assistant to the president.

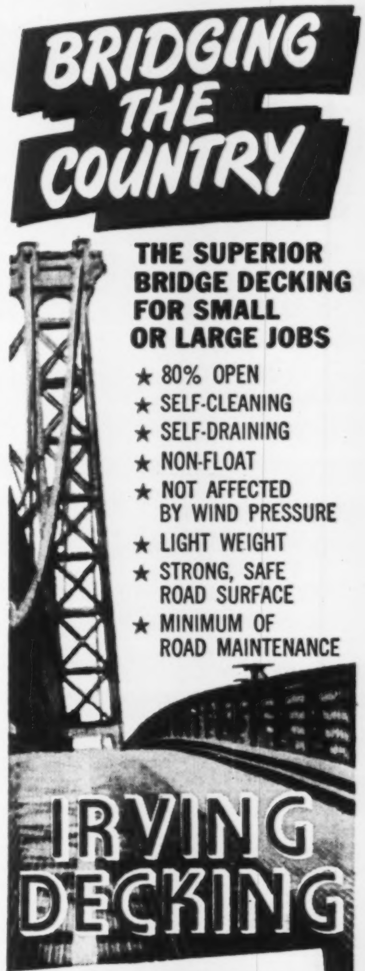
Harvey F. Ludwig, sanitary engineer director in the Office of the Surgeon General, U.S. Public Health Service, recently served as a member of three-man team studying the disaster relief operations conducted during the recent floods in Holland. The project was under the auspices of the National Research Council's Committee on Disaster Studies.

Vernon Gevecker

Vernon A. C. Gevecker, associate professor of civil engineering at the University of Missouri School of Mines and Metallurgy, has been appointed assistant dean of the faculty. An alumnus of the school, Dean Gevecker has been teaching there since 1938. He is currently serving as president of the Mid-Missouri Section of ASCE and secretary of the Missouri-Arkansas section of the American Society for Engineering Education.

Paul A. Kelly, formerly with Kelly & Gruzen of New York City, is now a member of the Malan Construction Corp., Long Island City, N.Y., and has been elected vice-president of the firm.

T. M. Osborne, manager of the chemical department of Koppers Company, Inc., has been placed in charge of the newly-combined chemical and gas departments of the engi-



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neering and construction division. Before joining Koppers in 1947, Mr. Osborne held the rank of brigadier general in the Army Corps of Engineers and served as chief engineer at Teheran, and commanding general of the Ninth Port and South District, Persian Gulf Command.

Glenn W. Holcomb, ASCE Director for District 12, has been named head of the civil engineering department at Oregon State College, to fill the vacancy caused by the death of **Prof. Charles H. Mockmore.**

Frank L. Martin has retired as a member of the faculty at Pennsylvania Military College after 27 years of service. A retired Marine Corps major, Professor Martin taught in the physics and civil engineering departments, and was student adviser and head of the civil engineering department.

Arthur H. Herberger, formerly director of the Division of Sanitation, Nassau County (New York) Health Department, is now town engineer for Hempstead, N.Y.

G. Brooks Earnest, newly installed president of Fenn College, received the degree of doctor of engineering from Case Institute of Technology on June 4. An alumnus of Case, class of 1927, Professor Earnest was a member of the faculty from 1930 to 1951, when he went to Fenn College as dean of engineering. He is ASCE Vice-President for Zone III.

Lowell J. Stephenson, project engineer for Porter, Urquhart & Beavin on Section 8 of the Garden State Parkway project for the New Jersey Highway Authority, has been transferred to the West Coast. His successor is **Crawford F. Grigg.**

Robert A. Thompson, Jr., succeeds **W. D. Masterson** as manager of the San Antonio (Tex.) Water Board. Until lately he was assistant manager.

Stanley J. Johnson (left) congratulates his successor, W. G. Shockley, upon his assignment as chief of the Embankment and Foundation Branch of the Soils Division, Corps of Engineers, Waterways Experiment Station, Vicksburg, Miss. Mr. Johnson recently resigned after seven years with the Corps to accept a position as chief engineer at the Montclair, N.J., office of Greer & McClelland.

J. J. Polivka (left) consulting engineer of Berkeley, Calif., and lecturer at Stanford University, is shown receiving the French Legion of Honor Medal of Etoile de Benin from Louis de Guiringaud, consul general of France at San Francisco, at a recent meeting of the Alliance Francaise.

Richard H. J. Pian, has been promoted from assistant to associate professor of civil engineering at Michigan State College. He has been a member of the graduate faculty since 1949.

Austin W. Earl has been appointed consulting engineer to the Division of San Francisco Bay Toll Crossings, succeeding **Ralph A. Tudor,** who was recently appointed Undersecretary of the Interior. Mr. Earl is a partner in the San Francisco firm of Earl & Wright, Consulting Engineers.

Thomas H. MacDonald, who recently retired as chief of the Bureau of Public Roads, was honored in a citation prepared by the executive committee of the Associated General Contractors of America, as "having done more than any man in the nation for the development of its highway system." An Honorary Member of ASCE, Mr. MacDonald is now establishing a Transportation Institute at Texas A & M College.

Charles A. Maguire & Associates announce that **Frederick H. Paulson, Milton E. Nelson, William A. Fisher,** and **Howard W. Holmes** have been admitted to the firm as partners. **Wendell S. Brown** will act as special consultant.

John G. Marr, since 1946 city planning engineer for the city planning commission of Oakland, Calif., was recently named special assistant to Undersecretary Ralph A. Tudor, of the Department of the Interior.

Howard E. Moses, director of the Bureau of Sanitary Engineering, Pennsylvania Department of Health at Harrisburg, has been elected chairman of the Ohio River Valley Water Sanitation Commission. **F. H. Waring,** chief engineer of the Columbus, Ohio, department of health, was reelected secretary.

W. V. McMenimen, former vice-president and now vice-chairman of the board of directors for the Raymond Concrete Pile Co., New York, N.Y., was presented with a bronze plaque depicting projects with which he has been connected during his career,

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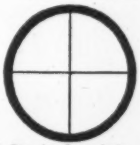

Fig. I—Cross hair arrangement for our standard levels.

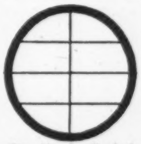

Fig. II—Stadia hair arrangement for our standard transits.

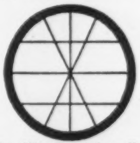

Fig. III—Special stadia hair arrangement, furnished upon request.

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at a testimonial dinner at the Waldorf-Astoria, New York City, on May 28. He was also given a diamond-studded gold service emblem for 40 years of service.

Clarence E. Ellsworth was recently honored at a reception and dinner on the occasion of his retirement as Texas district engineer for the U.S. Geological Survey. Mr. Ellsworth has been with the Texas District at Austin since 1918.

C. Calor Mota, professor of civil engineering at the University of Puerto Rico, received the degree of doctor of science from the University of Madrid, on June 1. While in Spain he was invited by the American Embassy to lecture on "The Future of Puerto Rico."

Miguel A. Quinones was recently advanced from chief design engineer for the Puerto Rico Water Resources Authority to chief engineer.

Perry J. Freeman, after more than 19 years with the Tennessee Valley Authority, at Knoxville, Tenn., retired as head materials engineer in the Division of Design, on April 9. Mr. Freeman, who was in charge of inspection and testing of materials and equipment used in the construction of TVA projects, is planning to live in Tallahassee, Fla.

Vito A. Vanoni, associate professor of hydraulics, California Institute of Technology, has been elected a member of the Pacific Southwest Regional Committee of the American Geophysical Union, for a three-year period ending in 1956. Dr. Vanoni is on the staff of the Caltech Hydrodynamics Laboratory.

George M. Webb, since 1952 assistant planning engineer for the California Division of Highways at Sacramento, was recently designated traffic engineer. He began his career with the highway division 25 years ago.

F. C. Woermann has become chairman of the board of the Woermann Construction Co., St. Louis, Mo., after 40 years as president of the company. He will be succeeded as president by **R. E. Salveter,** executive vice-president for the past six years. **J. W. Graves** was named vice-president in charge of construction operations and **H. H. Himebaugh** continues as vice-president in charge of estimating and purchasing.

Glenn E. Sherman recently took a position as sales engineer with the Buffalo Slag Co., Inc., Buffalo, N.Y. He was previously an engineer for the New York State Department of Public Works at Buffalo.

W. Brewster Snow is leaving Duke University where he has been serving as associate professor in the college of engineering, to take the post of chairman of the civil engineering department at Rutgers University.

Henry Willcox has retired as president and chief engineer of the Willcox Construction Company, Inc., Long Island City, N.Y. The name of the corporation he headed is now changed to C. E. Youngdahl & Company, Inc.

Fritz Zapf, since 1946 president of the San Diego (Calif.) Construction and Engineering Co., Inc., is now serving as city street superintendent for San Diego.

Solution to problem on page 49

Apparently, steam had formed in the heater, forcing some water back up into the storage tank. Then as the fire died down, or as hot water was drawn from the heater, this cold water returned. As a result, the steam in the heater condensed, forming a vacuum too rapidly to be relieved by the $^1/_2$-in. water pipe. The tank therefore collapsed, tearing at one of the sharp folds—a failure which many attributed to inside pressure, but one which was actually due to a negative pressure.

The remedy was to extend a small vent pipe some 10 or 12 ft vertically above the heater tank to carry away any steam that might form.

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Tampa Bay survey. . .

(This article begins on page 43)

(Continued from page 45)

would be a very tedious job as is so often the case, but we were pleasantly surprised. This phase of the work was completed in a relatively short time with most of the observations made during the daylight hours, generally morning or twilight. Night observations were necessary in only one direction, thus avoiding the many difficulties caused by night transportation and communication on the bay and the confusion of the hundreds of varicolored navigation and shore lights, some fixed and some blinking, in competition with our own survey control lights.

Probably the two factors that contributed most to the rapid and accurate completion of this part of the work were the system itself, with its effective control towers, and the theodolite used—a Wild T-3. The T-3 is a direction type of instrument reading directly to tenths of a second, with possible estimation to hundredths of a second. It is a very accurate and fast-operating instrument and proved ideal for our work. With it, the various directions were observed using eight different initial positions on the horizontal circle, first with the telescope direct and then reversed, resulting in a set of 16 readings. This procedure was repeated at least four times, or as often as necessary to reach an acceptable mean value.

As the work developed and it became apparent what accuracy could be expected, a basis for acceptance or rejection of observed angles was adopted. This criterion was to have triangle and quadrilateral angular errors of closures not greater than $^1/_2$ sec. The average closure of all figures before adjustment of the angles was about 0.28 sec. Considering the many complications already discussed, especially that of excessive heat radiation over the long water distances, we were more than satisfied with these results.

The final phase in the development of the survey control system was the adjustment of the observed angles by a least squares method. Solution was by the Doolittle method—that method which, although it saves so much effort, still has a paradoxical name.

From the network of 12 triangles, there were set up 12 angle, 1 length, and 3 side equations for simultaneous solution—a total of 16 conditions.

The resulting adjustments to the various angles ranged from a maximum of 0.54 sec to 0.00 sec.

Construction work on the Lower Tampa Bay crossing is well under way as of June 15, 1953. Of the 32 main piers for Structure C, 28 have been started. Also, about $1^3/_4$ miles of the curved south trestle is in place.

The control system has proved very effective, giving us pin-point control under all weather conditions.

The original 11 miles of clear water is now broken up by stretches of hydraulic embankment and piers, and the once formidable-looking crossing has assumed a tamer appearance. One can easily visualize the many fisherman who, only a few years from now, will be trying their skill from the bridge decks far out in Tampa Bay, with typically nonchalant acceptance of a man-made engineering project, and completely oblivious to the 60-mph traffic whizzing along behind them.

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Men Available

SANITARY ENGINEER; A. M. ASCE; B.S. in S.E., M.C.E., Engr. Sc.D. pending thesis; registered New York and New Jersey; 8 years' progressive industrial experience including responsible charge of water supply, water treatment, waste disposal and water pollution abatement planning, design, operations, research and development for large chemical manufacturer. C-851.

ASSOCIATE OR ASSISTANT PROFESSOR; A. M. ASCE; 46; married; 10 years in engineering education, specializing in engineering graphics, (engineering drawing, descriptive geometry, nomography) and analytical mechanics. Until recently with prominent western university. At present engineering executive with California manufacturing industry; interested in fall appointment with western engineering college or university. C-852-522-A-12-San Francisco.

SANITARY ENGINEER; J. M. ASCE; 27; married; B.S. in C.E., M.S. in S.E.; 4 years' experience as assistant district engineer with state; desires position with industrial firm or consultant; will consider teaching. Location preferred, Missouri or Illinois area. C-853.

CIVIL ENGINEER; M. ASCE; and A.R.E.A.; 64; graduate of Prague Institute of Technology; immigrant; 40 years' consulting, design and contracting practice in general civil, hydraulics, railroading in Europe and South America. Desires position in Nebraska and neighboring states. Speaks English well. C-854-645-Chicago.

CIVIL ENGINEER; J. M. ASCE; 29; married; 8 years' experience covering planning, design, drafting, estimating, inspection on mill and industrial buildings; construction of military bases; large water control projects; state highway engineering. Location preferred, California. C-855-535-A-7-San Francisco.

CIVIL ENGINEER; A. M. ASCE; 44; married; 10 years' experience in canal design and specifications; 6 years' experience in concrete research. Desires teaching, design or specifications position. Location preferred, Midwest or West. C-856-535-A-11-San Francisco.

HYDRAULIC-MUNICIPAL ENGINEER; J. M. ASCE; 28; married; B.S. in C.E. and M.S. in hydraulics; registered; 2½ years' municipal and sanitary experience; 2 years hydraulic-hydrologic study and design. Desires responsible position investigation and design work. Location preferred, foreign or East Coast, but will consider other locations. C-857.

STRUCTURAL ENGINEER; J. M. ASCE; 27; married; B.S. in C.E., majored in structures; design, detail and inspect construction of reinforced concrete hydroelectric power plants for 2 years; detail large reinforced-concrete structures for 1 year; chief of survey party for 8 months. Location preferred, western United States. C-858-536-A-1-San Francisco.

CIVIL ENGINEER; A. M. ASCE; 52; married; graduate; registered in Ohio and Oregon; 28 years' experience in sanitary engineering in municipalities; 2 years' with consulting engineers on design and specifications for sewage treatment plants for smaller cities. Desires to return to municipal field as sewer, sanitary or city engineer. C-859-536-A-2-San Francisco.

MANUFACTURING EXECUTIVE; A.M. ASCE; 47; married; advanced degrees; many years administrator engineering development, industrial engineering, manufacturing; also, experience sales, accounting, personnel, finance. Well-rounded background enables training others and moving to greater responsibilities. Automotive, aircraft, machinery, materials. Excellent health. Location preferred, West Coast. C-860-456-D-3-San Francisco.

REGISTERED CIVIL ENGINEER; A. M. ASCE; age 41; offers 12 years' of administrative experience in public works construction and maintenance to position of senior civil engineer, office engineer or district industrial sales manager for engineering or consulting organization; or position of public works director or engineer for plant or municipality. C-861.

CIVIL ENGINEER; A. M. ASCE, age 28; Swedish graduate, desires position, preferably in Chicago area, involving business, engineering and initiative; 5 years' experience design and construction water treatment plants; also general importing business South America. Speaks excellent English, Spanish, Swedish, good German, Danish, some Portuguese and French. C-862.

CIVIL ENGINEER; A. M. ASCE; 36; married; registered Michigan; field and office on railroads, roads, drainage, highways, utilities, gas transmission, housing project, buildings; estimating for contractors and engineers; public speaking and conferences; maintenance and construction management at Naval Station; presently lieutenant

Permanent position with a progressive Western Ohio outfit available to a civil engineer, 30 to 40 years old. Position requires occasional travel. Experience in hydraulics desirable but not necessary. Applicants please give complete information including experience, current and past earnings, together with age, martial status, height, weight, complexion and unretouched side view photograph.

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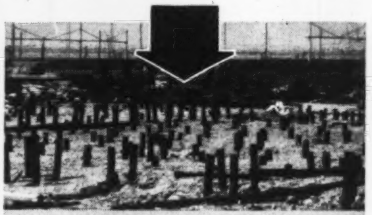

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● Driving pressure-creosoted timber piles with the big end down saved half a million dollars for Safeway Stores, Inc., on the construction of a warehouse in Kearny, New Jersey, by the Turner Construction Company. Alexander D. Crosett & Associates were the architects. A readily reachable stratum of sand, upon which the engineers intended to support the piles, was not sufficiently thick or dense to prevent the 8-inch-tip piles from punching through. Piles long enough to reach a lower stratum adequate to support the structure, would have been difficult and extremely costly.

To meet this unusual situation, the foundation consultants on the project, Moran, Proctor, Mueser and Rutledge, recommended that the timber piles be driven with the large end down. 8-inch-tip, 12-inch-butt pressure-creosoted piles were driven at about 6-foot center-to-center to support the building.

This butt-end down system made the installation of extremely long piles unnecessary, and resulted in very large savings. In addition, a considerable amount of valuable time was saved—time which would have been consumed in driving long piles. The driven piles, over 7500 of them, were remarkably firm laterally, withstanding individual load tests of twice their designed intensity, i.e., 25 tons.

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CIVIL ENGINEER; J. M. ASCE; 30; married; desires teaching position in structural engineering and allied subjects; teaching experience, including 10 years' of diversified responsible experience in structural and foundation engineering, including bridges, turnpikes, buildings, railroads, aircraft; M.C.E., P.E. Eastern university desired. C-864.

Positions Available

RESIDENT ENGINEER, 30–40, graduate in civil engineering or building construction or mechanical engineering work, with at least 4 years' experience on actual supervision of construction of industrial buildings, preferably also some work on commercial buildings. Preferably also 2 years' in engineering design work, such as computations, drawings, estimates and specifications. Salary, $6,000–$9,000 a year. Location, upstate New York. Y-8226.

CIVIL ENGINEER, 26–35, graduate, with concrete experience for construction. Salary, $3,900–$4,800 a year. Location, southeastern United States. Y-8237.

FIELD ENGINEER, civil or mechanical graduate, with industrial building or heavy construction, experience, to give line and grade, check equipment drawings and foundations, do cost work on chemical and refinery construction. Considerable traveling in United States. Salary, $4,200 a year plus $7.50 per diem. Y-8270.

STRUCTURAL ENGINEER with 10 to 15 years' experience in reinforced concrete and structural steel design for electric utility work. Location, eastern Pennsylvania. Y-8331.

CONSTRUCTION ESTIMATOR AND COST CONTROL MAN, thoroughly experienced in quantity take-offs and estimating and have successful performance record in competitive bidding. Cost control experience required. Background in power plant work, process piping and general industrial construction absolutely essential. Should have been successful as a chief estimator. Location, Pennsylvania. Y-8409.

INSTRUCTOR, young, in civil engineering who is also able to teach mathematics. Must have a master's degree. Location, New England. Y-8436.

CIVIL ENGINEER with over 18 months' experience as project engineer in foreign field office; with at least 25 years' in responsible charge of such work; in good physical condition. Will take responsibility for hydraulic studies and preliminary engineering in new hydroelectric developments; also supervision of maintenance of existing structures. Headquarters, New York, N.Y. Y-8466 (*a*).

STRUCTURAL ENGINEER, graduate, for design and estimating of radio, television, transmission towers and kindred structures. Previous experience in this field not necessary, but should have interest in stress analysis. Location, New York, N.Y. Y-8487.

MUNICIPAL ENGINEER with experience in design and construction of sewers. Must be registered in Ohio or able to obtain registration. Starting salary, $5,000–$6,000 a year. Location, Ohio. Y-8505.

CIVIL ENGINEER for work in the mechanical department, with duties consisting of some design drafting, office engineering and field supervision, and other work as assigned. Salary, $7,800 a year to start. Location, Chile, S.A. Y-8507 (*a*).

FIELD ENGINEER with construction and plant engineering experience in beverage fields, to supervise installation and operation of bottling plants. Must speak Spanish. Considerable traveling in South America. Salary, $6,000 a year plus expenses. Y-8525.

CHIEF OF LAND PLANNING, Engineer IV, to perform engineering investigations for the purpose of assisting in the development and maintenance of a comprehensive, long term general plan for physical and economic land development; location and arrangement of civic centers and all other public buildings; developing standard and principles governing the subdivision of land and recommended patterns for community design and development; conducting a survey of housing conditions and needs, etc. Two-year contract; transportation paid both ways upon completion of contract; housing provided at nominal rental fee. Total salary, $7,475 per year. Location, foreign. F-8642.

ENGINEERS. (*a*) Sanitary Engineer, must have degree and 5 years of actual experience, for design of water, industrial waste and sewerage facilities for established firm of consulting engineers. Permanent position. Salary open. (*b*) Structural Designer, engineering degree and a minimum of 6 years' experience on reinforced concrete. Must be professional engineer or qualified. Permanent position. Salary open. Apply by letter giving education, experience, references, salary requirements and availability. Location, Ohio. Y-8672.

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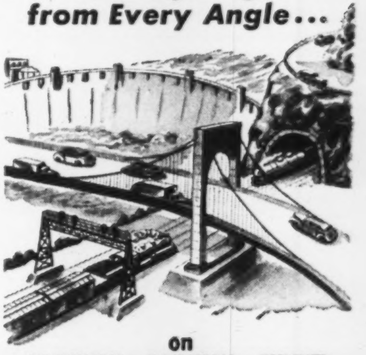

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Die Hebezeuge

Volume I: Grundlagen und Bauteile
Volume II: Winden und Krane

Volume I of this work, by Hellmut Ernst, on hoisting machinery covers fundamentals of design and construction of crane frames, cable drives, chain drives, simple load-lifting devices, shafts and bearings, brakes, couplings, electrical equipment, and other component elements. Volume II deals with the standard and most-used hoisting equipment: cable winches, grabs and grab winches, travelling cranes, electric hoists, wall-bracket and pillar cranes, self-propelling swinging cranes, rail and caterpillar-track cranes. Planning, erection, and operation of cranes are also considered. Vol. III will deal with special installations. (Fried. Vieweg & Sohn, Braunschweig, second edition. Vol. I—304 pp., DM 32.24. Vol. II—302 pp., DM 38.80.)

Tables and Formulas for Fixed-End Moments of Members of Constant Moment of Inertia

A comprehensive manual for structural design engineers that gives solutions of fixed-end moments for rigid frames and continuous beams, thereby eliminating the solution of any formulas. Each loading condition is separately indicated with a loading diagram, mathematical formulas, tables of fixed-end moment coefficients, and charts. (By Paul Rogers. Frederick Ungar Publishing Co., 105 East 24th Street, New York 10, N.Y., 1953. 95 pp., $3.75.)

Tables of Chebyshev Polynomials $S_n(x)$ and $C_n(x)$. (Applied Mathematics Series, No. 9)

A further addition to a series providing tabulated mathematical functions that previously have been wholly unavailable or available only in fragmentary or shortened form. The present table is to 10 decimals and has the usual, for this series, detailed introduction explaining the method of calculation and the specialized uses of the tabulated material. (National Bureau of Standards. For sale by Superintendent of Documents, Government Printing Office, Washington 25, D.C., 1952. 161 pp., $1.75.)

Wind-Tunnel Technique

A systematic account of the experimental methods employed in both low- and high-speed wind tunnels by R. C. Pankhurst and D. W. Holder. Major topics include wind-tunnel design, flow visualization methods, measurement of fluid velocity, tunnel interference effects, model construction, and the reduction of observations. Auxiliary apparatus and experimental analogies are discussed, and there is a separate chapter on special measurements such as stability and control, turbulence, and flutter. Extensive chapter bibliographies are provided. (Sir Isaac Pitman & Sons, Ltd., London, 1952. 702 pp., 57s6d.)

Theorie der Verbundkonstruktionen

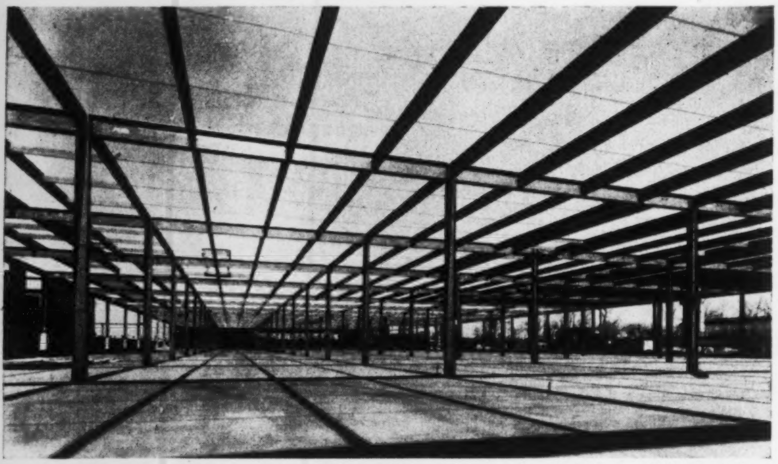
Starting with the fundamentals of creep and shrinkage of concrete, a consistent theory of composite construction is presented by the author, Konrad Sattler, covering all cases from simple steel and concrete structures to statically indeterminate prestressed composite I-beams and composite lattice girders. As it is intended for the practicing engineer, a considerable part of the book is devoted to numerical examples. (Wilhelm Ernst und Sohn, Berlin, 1953. 300 pp., DM 43.00.)

Water Supply and Sewerage

Ernest W. Steel presents an engineering treatment covering both design and operation in two related fields. The water supply material includes consumption of water, development of surface and groundwater supplies, pumps and pumping, water distribution systems, and methods of water treatment. The sewage part covers sanitary, storm, and combined sewer systems, pumping of sewage, stream pollution and recovery, and treatment methods of preparation of sewage for disposal. The general revision includes elimination of obsolete material as well as the incorporation of recently developed practices. (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, third edition, 1953. 582 pp., $8.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.



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New Publications

Engineering Standards. The Proceedings of the Third National Standardization Conference, held in conjunction with the Centennial of Engineering in Chicago last September, have just been published by the American Standards Association. Combined with the proceedings are the principal addresses presented at the Association's 34th annual meeting award luncheon held in New York in November. The publication is entitled *Standards–Engineering Tools for Industry,* the theme of the Standardization Conference, and runs to 64 pages. The papers feature standardization experience and practices in industrial construction and home building, chemicals, safety, purchasing, photography, welding, and in the international field. The booklet is sold by the American Standards Association, 70 East 45th Street, New York 17, N.Y., for $2.

Asphaltic Roads. The recently released *Manual on Design and Construction of Asphaltic Roads and Streets,* written and published by the Pacific Coast Division of the Asphalt Institute, is devised to cover all circumstances under which the engineer is compelled to operate. Formulas based on acceptable methods of analysis are provided where laboratory facilities are unavailable. The second section (on field operations) contains new methods for classification and analysis of aggregate combinations for the better control of asphalt mixtures. Copies are available from the San Francisco office of the Institute (Russ Building) at $1.50 each.

Careers in the U.S. Air Force. Information about job opportunities in the professional, scientific, administrative, and technical fields and the advantages of undertaking these careers with the Air Force is set forth in a recent publication of the Department of the Air Force entitled *Careers for Civilians.* Inquiries should be addressed to the Chief, Placement and Employee Relations Division, Office of the Director of Civilian Personnel, Department of the Air Force, Washington 25, D.C.

Pollution Control. Activities of the New England Interstate Water Pollution Control Commission and its member states in controlling pollution of interstate water resources for the year ending June 30, 1952, are summarized in the Fifth Annual Report of the Commission. Inquiries concerning the report should be sent to the headquarters of the Commission at 73 Tremont Street, Boston 8, Mass.

Highway Research. Studies looking toward a reduction in the cost of bridge and highway structures through the establishment of minimum design standards consistent with practical needs—conducted by the Bureau of Public Roads and the Texas Engineering Experiment Station—have been set forth in Station Bulletin No. 127, entitled *Method of Converting Heavy Motor Vehicle Loads Into Equivalent Design Loads on the Basis of Maximum Bending Moments.* Authors of the 568-page, paper-bound bulletin are Henson K. Stephenson and Kriss Cloninger, Jr., of the Texas A & M research staff. Requests for copies, which sell for $3, should be addressed to the Texas Engineering Experiment Station, Texas A & M College System, College Station, Tex.

Structural Design. As its first publication resulting from research work for the Robberson Steel Co., of Oklahoma City, the Engineering Experiment Station of Oklahoma A & M College has issued a report of a new method of stress analysis for continuous highway bridges. Entitled *Influence Lines for Frames with Constant Moment of Inertia and Sidesway Prevented,* the 130-page report is identified as Station Publication No. 85 and Robberson Steel Research Series Report No. 1. Copies of the publication, which is written by Jan J. Tuma, associate research professor of civil engineering, may be obtained from the Engineering Experiment Station, Oklahoma A & M College, Stillwater, Okla., for $1.25.

Surveying. A collection of short articles on unusual surveying problems and their solution has been published under the head, *The Surveyor's Notebook—Series Two,* by W. & L. E. Gurley, veteran manufacturers of engineering and scientific instruments. Free copies are available from W. & L. E. Gurley, Troy, N.Y.

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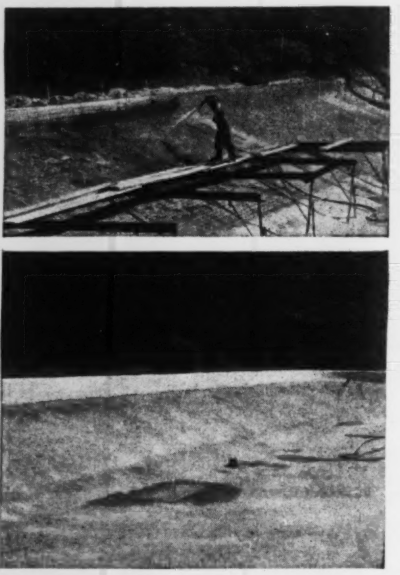

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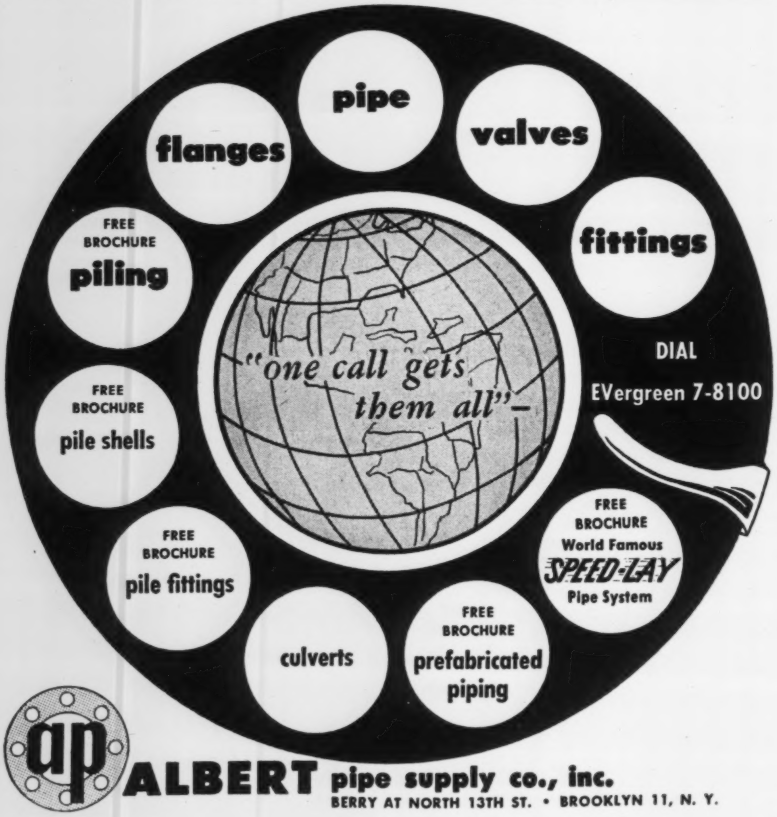

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Non-ASCE Meetings

Fourth Symposium on Plasticity. The Fourth Symposium on Plasticity will be held on the campus of Brown University, September 1–3. Papers of particular interest to civil engineers will be presented in one session—sponsored jointly by the Engineering Mechanics Division of ASCE and the University—on Tuesday afternoon, September 1. Further information may be obtained from Prof. H. J. Weiss, Graduate Division of Applied Mathematics, Brown University, Providence 12, R.I.

Summer Program in City and Regional Planning. The fifteenth in the annual series of special summer programs in city and regional planning will be held at the Massachusetts Institute of Technology, August 21–September 4. Featured in this year's schedule are several sessions on schools in community planning. Seminars will be under the direction of Louis B. Wetmore, visiting professor of city planning at M.I.T. Further information and application blanks may be obtained from the Director of the Summer Session, Room 3–107, Massachusetts Institute of Technology, Cambridge 39, Mass.

Society of Automotive Engineers. The international West Coast meeting of the Society of Automotive Engineers will meet at the Georgia Hotel, Vancouver, British Columbia, August 17–19.

Third International Congress on Soil Mechanics and Foundation Engineering. The first part of the Third International Congress on Soil Mechanics and Foundation Engineering will be held at Zurich, Switzerland, August 16–21. Following a four-day trip through Switzerland (August 22–25), the Congress will hold its final session at Lausanne on August 26. All correspondence relative to the Conference should be addressed to Dr. I. von Moos, General Secretary, Gloriastr. 39, Zurich 6, Switzerland.

Positions Announced

New York District, Corps of Engineers. An urgent need for engineers to fill the position of safety engineer (construction), with a GS-9 rating at a yearly salary of $5,060, is reported by the New York District of the Corps of Engineers. Duties of a safety engineer in this area include such jobs as checking and recommending safety measures on construction projects in New York and New Jersey. Applicants are required to have six years of engineering experience—four years of college may be substituted for the equivalent number of years in the field. For further information write to the Personnel Branch, Corps of Engineers, Office of the District Engineer, New York District, 80 Lafayette Street, New York 13, N.Y., or telephone Mr. Slomowitz, Worth 4-7300, ext. 572.

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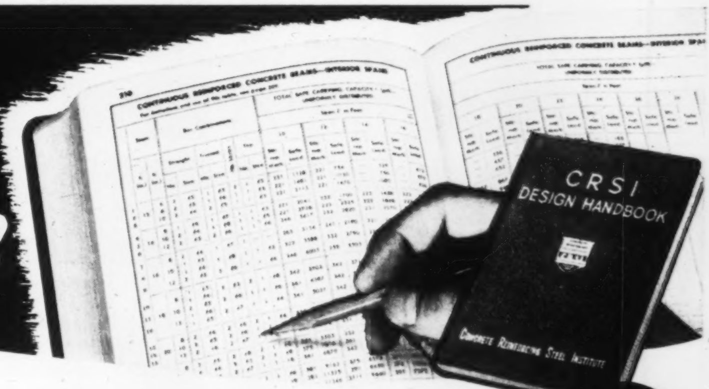

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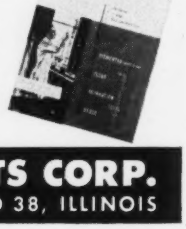

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Phiroz Bomanji Desai, Bombay, India.
Orville William Chinn, Frankfort, Ky.
Chalmers Carolyn Crump, Richmond, Va.
Norman James Drustrup, San Juan, Puerto Rico.
Albert Dominick Elia, Niagara Falls, N. Y.
Aubrey Grant, Rangoon, Burma.
John Hugh Greason, Poplar Bluff, Mo.
Edmund Schofield Hobson, Port Hueneme, Calif.
Marvin Forrest Johnson, Frankfort, Ky.
Myron Ross Jones, Canton, Ohio.
Ralph Durward Kinsey, San Francisco, Calif.
Francisco Lizardi, Santurce, Puerto Rico.
James Fletcher Main, Westminster, London, England.
John Harry McDonald, Atlanta, Ga.
Stephen Julius Meares, Jr., Balboa, C. Z.
Sidney Robert Mitchell, Minneapolis, Minn.
Charles Francis Mitchim, Fort Belvoir, Va.
Bernard Delbert Murphy, Billings, Mont.
Frederick Gates Peters, San Diego, Calif.
Samuel Augustus Pinson, Dallas, Tex.
Jack Kenneth Sexton, Montreal, Quebec, Canada.
Charles Elbert Shook, Atlanta, Ga.
Paul Eugene Stephenson, Sacramento, Calif.
Wilbur Nattan Torpey, New York, N. Y.
Enrico Giovanni Volterra, Troy, N. Y.
Donald Emerson Whelan, Upper Darby, Pa.
Clark Smith White, Atlanta, Ga.

Applying for Associate Member

Robert Ray Balmer, Wilmington, Del.
Morton Thomas Belvin, Jr., Dallas, Tex.
Harry Edward Blakeley, Atlanta, Ga.
Jess Walter Boughton, Jr., New York, N. Y.
Russell Lowell Cooper, Kansas City, Mo.
Ora Avis Dennis, Tacoma, Wash.
Sam Worthington Didsbury, Uganda, East Africa.
George Economou, Addis Ababa, Ethiopia.
David Edward Fleming, Denver, Colo.
David Hoskins Giddy, Johannesburg, South Africa.
Martin Shahrazar Johns, New York, N. Y.
Robert Farrar Johnson, Portland, Oreg.
Robert George Kachmarik, Port Movesby, Australia.
Harry Ralph Keller, Salem, Oreg.
Wen-Hsiung Li, Baltimore, Md.
William Seward Mariner, Boston, Mass.
Jeff Davis Reagan, Jr., Beaumont, Tex.
William Charles Sperry, Hampton, Va.
Edward Elmer Spoonhour, Portsmouth, Ohio.
Archie Allan Stone, Richmond, Calif.
Abba Tor, Denver, Colo.
Charles Pao-Chun Tung, New York, N. Y.
Gerard Witt, Milwaukee, Wis.
Chi-Ko Yang, Columbus, Ohio.
Peary Albert Zetterlund, Chicago, Ill.

Applying for Junior Member

Narcy Firouz, Bethesda, Md.
Karl George Frese, Jr., Miami, Fla.
Harold Stewart Gillis, Jr., Richmond, Va.
John Jones, Los Angeles, Calif.
Renato Junqueira de Andrade, Ithaca, N. Y.
Robert Richard Kayne, Wichita, Kans.
George Andrew Kennedy, Chicago, Ill.
Nauroz Khan, San Francisco, Calif.
Kenneth Royce Kvammen, Los Angeles, Calif.
Robert Lipian, New York, N. Y.
William Ivan Matotan, Albuquerque, N. Mex.
Samuel Warren McCleskey, Jr., New York, N. Y.
Walter Kenneth Morris, San Francisco, Calif.
David Navon, New York, N. Y.
Charles Albert Orne, Jr., Cambridge, Mass.
Charles Arthur Redman, Kansas City, Mo.
William Devoy Mooney Reeves, Fresno, Calif.
George Franklin Shofner, Richmond, Va.
George Bunyan Smith, Vicksburg, Miss.
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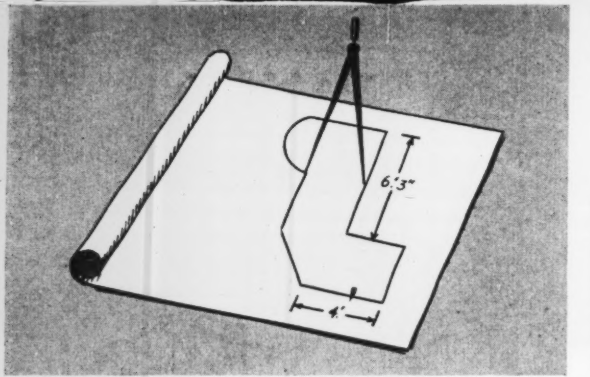

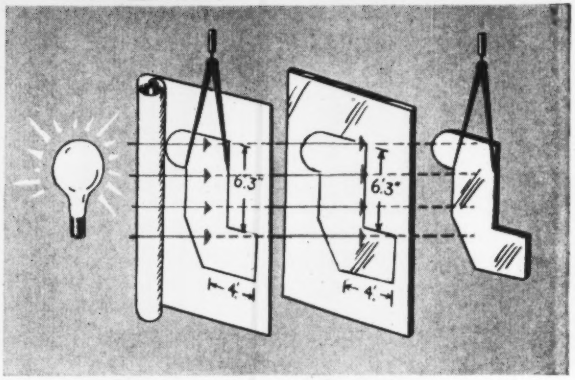

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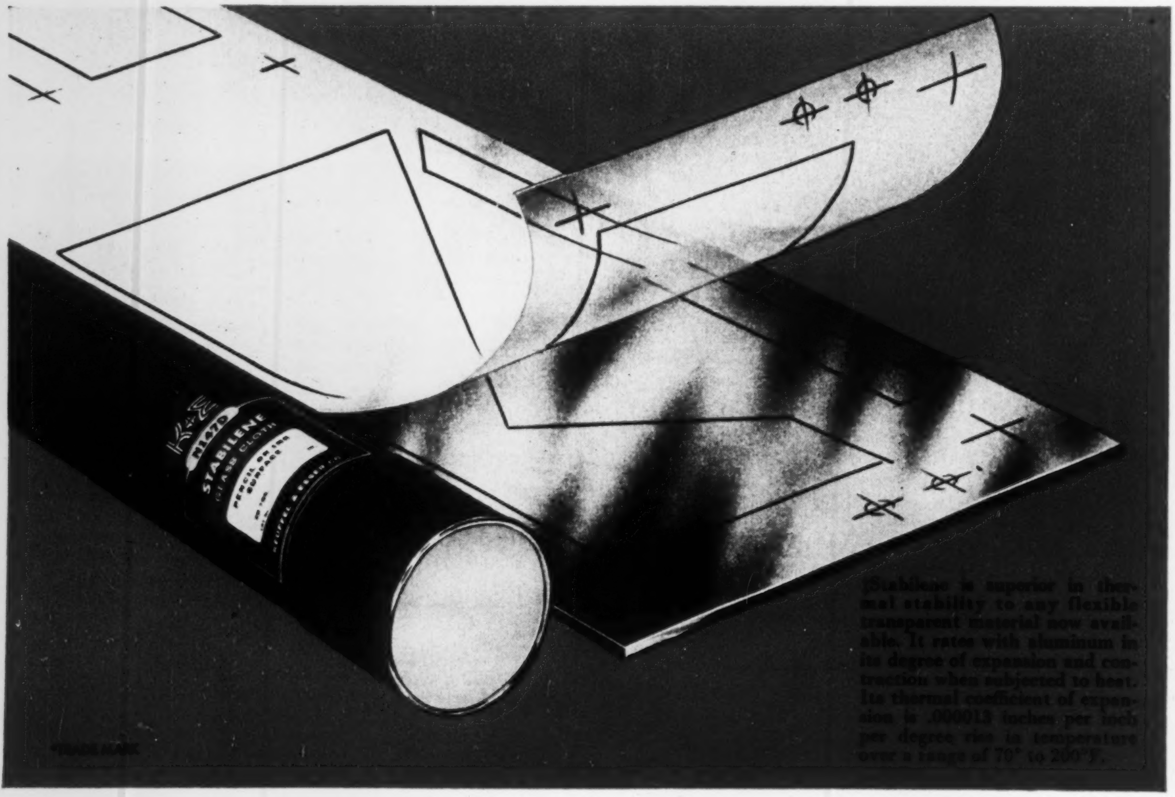

†Stabilene is superior in thermal stability to any flexible transparent material now available. It rates with aluminum in its degree of expansion and contraction when subjected to heat. Its thermal coefficient of expansion is .000013 inches per inch per degree rise in temperature over a range of 70° to 200°F.

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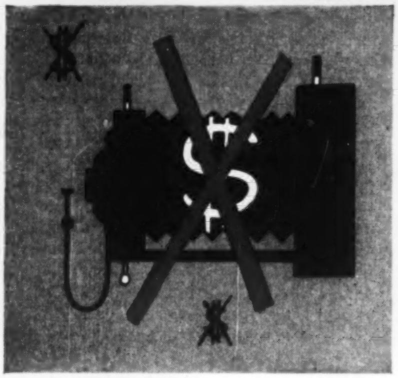

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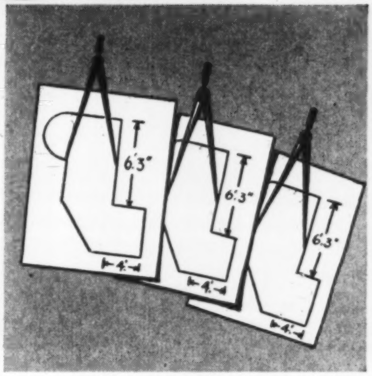

"DUPLICATE ORIGINALS" FROM STABILENE: Stabilene, itself sensitized for reproduction, can be used for dimensionally stable "duplicate originals." Such reproductions made on Stabilene are easily shipped to sub-contractors in lightweight rolls. "Duplicate originals" can also be used as the basis for design changes, new drawings, or composite drawings.

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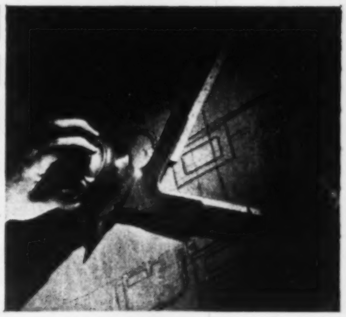

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Heavy Duty Ripper

An over-the-mold-board heavy duty ripper for all medium and large dozers has been announced. Carefully selected and heat treated steels make the ripper rugged enough to absorb the toughest ripping jobs. Valuable tool for the contractor where grade has been lost or corner cuts required. Up to six units can be used on a dozer for grubbing, clearing and rock raking. Leading construction firms are already using this ripper with excellent results. The complete unit weighs approximately 300 lbs. This feature makes it possible for one man to handle it. Request Form #1000. **Hensley Equipment Company, CE 7-110, P. O. Box 837, San Leandro, Calif.**

Excavator

A completely re-engineered model of the tractor-powered, hydraulic Pippin excavator is on the market. The Deluxe Model WF-104 attaches to light tractors such as Ford and Ferguson, and is being adapted to other makes of tractors. It excavates over 10 ft deep, and will lift to a height of 12 ft for truck loading. Its 16 ft reach behind the tractor means that a 10 ft long trench can be dug without moving the tractor. Wider side swing ($12^1/_2$ ft from center) allows piling of dirt farther from the excavation. Besides heavier construction throughout, the power of the bucket is increased 300 percent through hydraulics and leverage. The excavator is rigidly supported by its two hydraulic stabilizers, which relieves the tractor of the working stresses, and assures digging of plumb ditches on uneven ground or on slopes up to 15-deg. The greater hydraulic tank capacity provides better oil cooling under extreme working conditions. A wide variety of buckets, back-hoes and shovels greatly increases the excavator's usefulness to building, plumbing, electrical and construction contractors, state and municipal departments, etc. **Pippin Construction Equipment, Inc., CE 7-110, White River Junction, Vt.**

Model WF-104

Dump Body

A 20-ton capacity tandem axle straight bed dump body, the Morgantown, is announced. The body is constructed of 10 gauge steel with a full size cab protector. Overall body length is 20 ft. It is 84 in. wide at the floor level and $95^1/_2$ in. wide at the point where side boards are inserted. Ends are 52 in. high with box-type corner posts which anchor two 11 in. removable steel side boards. Body is amply reinforced by 6 steel V type braces and has a double-acting tailgate 35 in. high, with cast steel and malleable iron heavy duty hardware. Dumping is handled by a Galion Model 77353 hoist. This consists of two 7 in. twin ram 3-stage twin telescopic cylinders. Rated hoist capacity is 20 tons. **The Galion Allsteel Body Company, CE 7-110, Galion, Ohio**

The Morgantown

Salt Road

There are, even in this age of widely publicized advances, some products and methods which are well liked, often used, yet not too well known. Such is a salt stabilized road. Briefly, a salt stabilized gravel road is one that is well held together, tough and dependable. It is made by mixing salt (at the rate of about 4 tons per mile to the average road) with the aggregate, wetting it, rolling it and letting it dry into one of the finest, most economical roads to be had. Not only does salt do an excellent job of stabilizing but it also provides the added advantage of less dust, practically no frost boiling, and a minimum loss of expensive aggregate. The Morton salt itself is economical, easy to use and always available. A salt stabilized road prevents accidents due to loose gravel. In addition to its primary use as a stabilizing agent for secondary roads The salt is also used as a stabilizing agent for base courses for primary roads, alleys, parking areas, airports, private driveways, etc. **Morton Salt Company, CE 7-110, 120 So. La Salle St., Chicago 3, Ill.**

Plastic Sheets

Fiberglas reinforced polyester sheets are now available in sizes up to $4^1/_2 \times 8^1/_2$ ft and in a variety of thickness. The sheets are made in two grades: Grade I—20,000 psi; Grade II—40,000 psi. Both grades have excellent dimensional stability and resistance to a great variety of chemicals which make them ideal materials for structural elements in corrosive atmospheres or baths. The materials also exhibit high arc resistance and low power factor which makes them excellent materials for use in the electrical and electronic industries. The material can be formulated in varying degrees of flexibility and can be molded to special shapes in low cost tooling. For additional data on flat sheets and molded shapes write **Strick Company, CE 7-110, Plastics Div., Whitaker & Godfrey Aves., Philadelphia 24, Pa.**

Bulk Material Handler

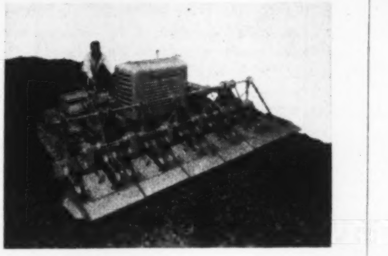
A Scoot-Crete bulk material handler has just been announced. The 3,000 lbs capacity unit, known as the Scoot-Crete Model N-52, is Diesel powered to increase operating safety in two ways: the proportion of carbon monoxide in the exhaust gas is greatly reduced, and the Diesel fuel is much less inflammable than gasoline. An accessory, available through Getman distributors and dealers, is a "Scrubber" that reconditions exhaust gases. The highly maneuverable N-52 will turn within its own 90 in. length because of its caster steering, is 43 in. wide and the operator's head is about 68 in. above floor-level. Gross empty weight is approximately 1,100 lbs. Operating speeds range from 1 to 15 mph through standard truck transmission. An automatic transmission having a high-speed forward and reverse is available at extra cost. The Scoot-Crete is equipped with either flat rack or 14, 16 and 20 cu ft dump box bodies. These can easily be interchanged on the job in just a few minutes. **Getman Brothers, CE 7-110, South Haven, Mich.**

SCOOT-CRETE
Scoot-Crete Model N-52

Equipment, Materials & Methods (Continued)

Vibro-Tamper

SINGLE-COURSE construction of macadam roads and airport runways is made more efficient by means of the improved Vibro-Tamper. As ordinary rolling equipment is unable to compact more than a few inches of aggregate, conventional macadam construction requires two or three 5 in. courses individually compacted. Due to the Vibro-Tamper's efficient use of vibrating and tamping forces, the engine sub base for a road or macadam runway can be laid in one operation to a depth of up to 12 in. The Vibro-Tamper, by applying the proper vibrating and tamping forces, can compact in several passes a single 12 in. course to 9 in. compacted thickness of 95 proctor density. In waterbound work, it runs in screenings in as low as 2 passes, saving 50 percent of the time formerly required for spreading, brooming and rolling. The Vibro-Tamper is powered by an 85 hp industrial gasoline engine through a gear reduction that provides a 30 to 1 reduction to the crawler track. Power is supplied to the vibrating-tamping shoes through a V-belt drive from the engine to a 5-section flexibly-coupled line shaft. Power take-off at the shaft is accomplished by means of a newly-designed heavy duty enclosed chain drive at each of the six vibrating shoes. Power is transmitted to the oscillating eccentric gearing in each shoe gear box by means of a double V-belt drive. Use of the newly developed intermediate chain drive from the line shaft permits power transmission by belt from the pivot point of the shoe supporting arms so that belt slippage is eliminated when the shoes move over uneven ground. This greatly increases compaction efficiency under most operating conditions. In addition, use of the intermediate chain drive permits the use of open end sheaves, easily accessible for occasional belt replacement, to also simplify maintenance. Six 435 lb shoes are used to give the combined vibrating and tamping effect. Total contact area of the six shoes is 18 sq ft. Travel rate may be varied from 16 ft per min to $1^1/_2$ mph. Compacting force penetrates to a depth of 3 ft in granular material. The shoes are hydraulically raised to vertical nonoperating position for travel off the job. **The International Vibration Co., CE 7-111, 16702 Waterloo Road, Cleveland 10, Ohio**



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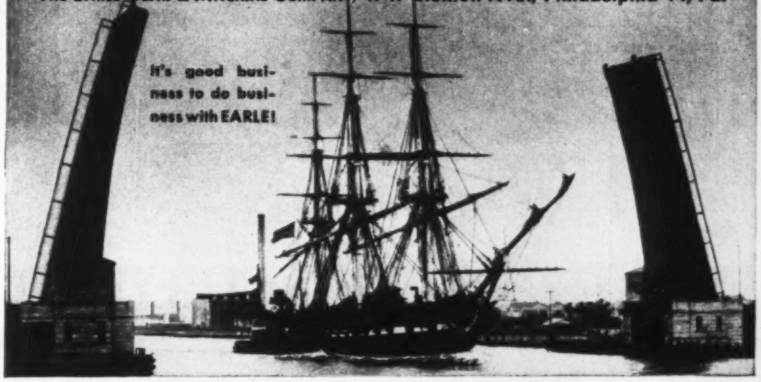

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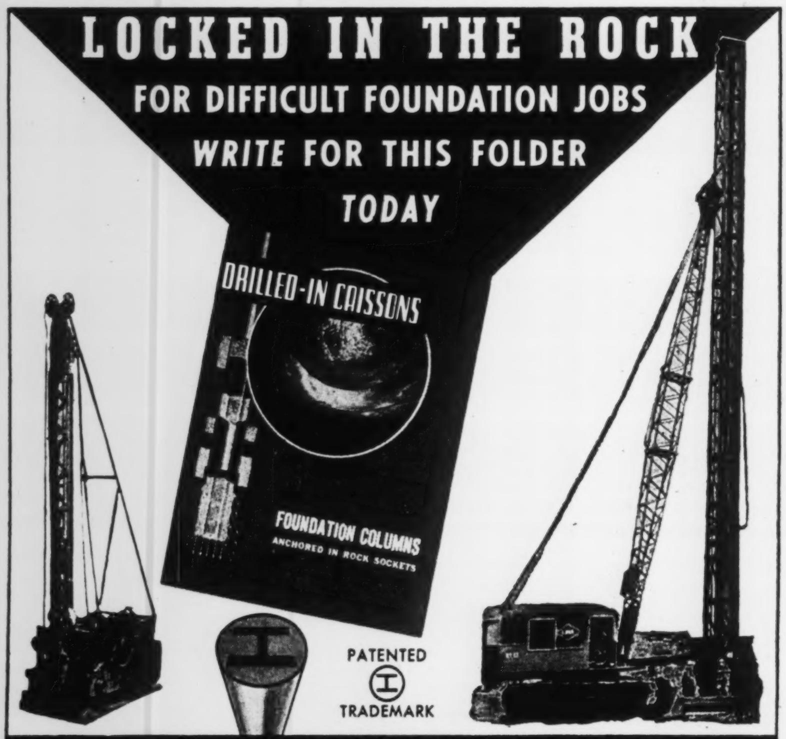

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Equipment, Materials & Methods (Continued)

Concrete Saw

A CONCRETE SAW was recently used by Anderson Brothers Contractors of Rockford, Ill., to saw vertically up concrete walls at the Ingersol Milling Machine Company's Rockford plant. This new and unusual sawing procedure was done in order to "tie in" new construction with the existing structure. By sawing to approximately $^1/_4$ the wall depth with a Model C-130 saw, Anderson Brothers were able to tie into the existing building wall; the sawed line confined the breaking of the concrete, leaving a smooth, neat existing corner post to which to anchor the new construction. The vertical sawing was made possible by placing the Clipper "ConSaw" on a winch operated platform and raising the saw and operator as the job progressed. The blade guard of the saw was mounted at such a position that the front edge of the blade was exposed rather than the lower portion. The entire saw was moved upward by the saw operator elevating the platform by means of the winch. Although the Model C-130 was not originally purchased for this vertical sawing job, this successful application shows the adaptability of this precision built machine. It has also been used to saw trenches for the laying of pipe lines. The sawed trench eliminated radial fracturing beyond sawed lines and permitted faster, heavier breakout methods. Only a minimum of material was removed and replaced and a smoother, finished job resulted. **Clipper Manufacturing Co., Suite 707, 2800 Warwick, Kansas City, Mo.**

Warm Air Ducts

A HOUSING DEVELOPMENT in the Chicago area reports a savings in labor of $44.00 per house through the use of Transite Warm Air Duct in the perimeter heating system. The savings can be traced largely to the long lengths of the Transite. The 2 in. to 7 in. diameters come in 10 ft lengths; the 8 in. to 12 in. sizes come in 13 ft lengths. This reduces joints to a minimum, simplifies assembly and speeds up leveling operations. The ducts, even in the longest lengths, are light in weight so one man can handle them. They are quickly laid to grade and joints are completed in a matter of minutes. For air inlets, outlet registers and such, any cuts needed are easily and cleanly made. No anchoring to prevent floating or protection to avoid deforming is needed so the pouring of concrete can start at once. Then, the Transite becomes an integral part of the slab and is as long lasting. Transite Warm Air Duct is a product made of asbestos and cement. There is no possibility of rusting or corrosion since it is nonmetallic and there is no possibility of delaminating since Transite is inorganic. The smooth interior surface stays smooth in service assuring a high carrying capacity and easy maintenance of the heating system at peak efficiency. **Johns-Manville, CE 7-112, 22 East 40th St., New York 16, N. Y.**

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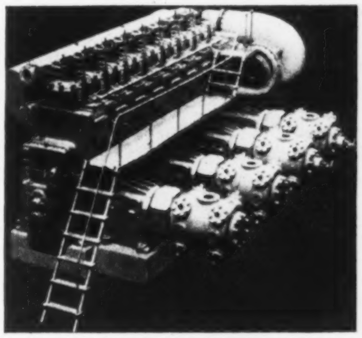
Equipment, Materials & Methods (Continued)

Engine for Tandem Rollers

THE AVAILABILITY of a Caterpillar engine for the Huber Mfg. Company's line of 8–12 and 10–14 ton tandem rollers, is announced. It is the Caterpillar Model D-315 diesel engine, which develops 66 hp at governed speed. The engine has a $4^1/_2$ in. bore, a $5^1/_2$ in. stroke, and 350 cu in. displacement. Huber currently furnishes Hercules gasoline and diesel engines for this line and will continue to do so. These are the Hercules JXD (gasoline) and Hercules DJXC (diesel). Features of the company's tandem rollers include: design for practical and efficient field service; unit-welded frame; power transmitted through Twin-Disc fluid coupling; exclusive yoke design to help eliminate "scuff"; dual controls featuring "variable speed" steering; internal bracing on guide rolls to eliminate side thrust on heads, from turning or curbing pressures; and unusually close curb clearance. **Huber Manufacturing Company, CE 7-113, Marion, Ohio**

Compressor

THE MODEL TRA is America's first turbocharged 2-cycle right angle gas engine-driven compressor unit. It sets new standards both for fuel economy and for station auxiliary requirements. The Clark Model TRA-8, which develops 1320 brake hp, has eight vertical, in-line cylinders of 14 in. bore and 14 in. stroke, integrally connected to horizontal compressor cylinders. The TRA represents a unitized, integrated design. Turbocharger and compressor have been specifically designed and built by Clark to operate as a perfectly matched, balanced unit. In addition to the TRA-8, other Clark "angle" compressors are now available as turbocharged units with comparable increases in power and operating economies. These are some of the outstanding features: fifty percent more power; new lows in fuel consumption; 25 percent less water cooling load; flat fuel consumption curve; quieter operation; and compact, yet accessible, 2-cycle in-line design. Write for Bulletin No. 130. **Clark Bros. Co., CE 7-113, Olean, N. Y.**



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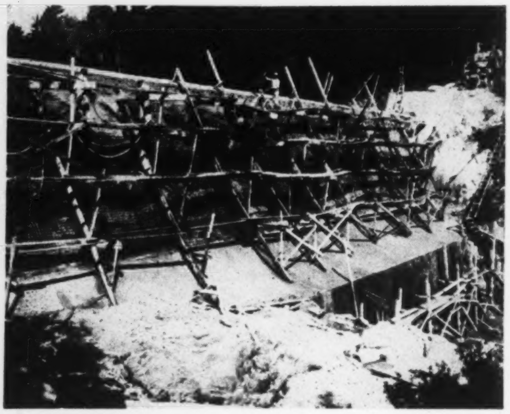

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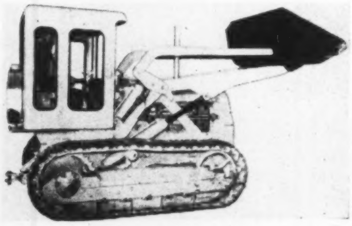
Equipment, Materials & Methods (Continued)

Tractor Cab

PRODUCTION OF HEAVY duty cabs for installation on the Caterpillar HT4 Traxcavator tractor has been announced. The Crenlo Cab, specially designed for crawler tractor service, is allsteel arc welded, eliminating need for bolted joints. The 12 gauge body is strongly reinforced by framing of $^3/_{16}$ in. thick structural members. Hinges and latch mechanism are heavy duty type and windows are $^3/_{16}$ in. safety glass mounted in self-sealing weatherstrip. A canvas curtain—removable for warm weather operation—extends from the bottom of the windshield to the dash and floor plate. Doors may be fastened in open position. Special engineering of Crenlo Cabs ensures long life under the extreme working conditions imposed on crawler tractor equipment. Cab design allows for maximum visibility and a view of the dozer blade in all attitudes. Access to controls is convenient, and engineering of cab structure permits the operator to use all normal types of allied equipment without modification of the cab. The Crenlo Cab is easy to mount. The base bolts directly to the tractor fender—hydraulic lines need not be broken for installation. **Dept. KP, Crenlo, Inc., Rochester, Minn.**



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TOUGH, FLEXIBLE and water-retardent flooring and surface coating materials which bind to masonry, concrete, plaster, wood, glass and metal are now available for the first time. The new materials which are available under the tradename of Surco, are similar to regular concretes or plasters but special latex-water emulsion binders instead of water alone are used as combining agent. To meet the varied demands of construction and maintenance, two general types of latex have been developed. Both are tough and have outstanding adhesive qualities, however, in one product the water-proofing qualities have been amplified and in the other the quality of wear resistance has been accentuated. Between the two materials, a wide variety of uses are possible such as floors, platforms, drives, sidewalks, airfields, highways, to water-proof, to stucco and plaster walls and as a concrete wherever vibration is a problem. **Surco, B-2, 110 Pear St., Atlanta, Ga.**

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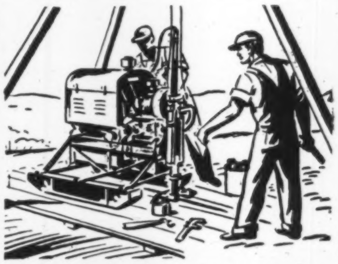

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Equipment, Materials & Methods (Continued)

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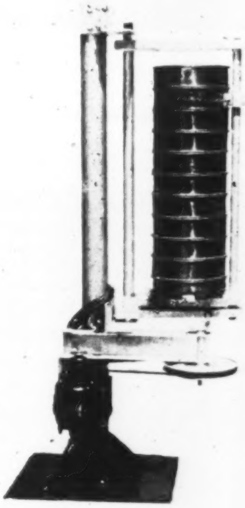
The Ward Sieve Shaker has been developed by a laboratory operator as a fast, efficient, and economical means of rapid and thorough segregation of grain sizes for cements, highway and construction materials, sand, clay and chemicals. Rugged simplicity has been obtained by the application (patent applied for) of two opposing rotary movements which result in the equivalent of a straight line oscillation. Material on the sieve receives approximately 500 shifts and taps per min. Production rates may be estimated from typical test curves of weight vs. time. Table space is not required as stand is supported on steel floor base 14 in. by 18 in. drilled for four $^1/_2$ in. diameter mounting bolts. Space occupied is 48 in. high, 14 in. wide and 22 in. long. Use of nonbreakable tubular steel construction for pedestal and frames insures rigid support and uniformly well distributed vibration throughout the entire stack. Space is provided for eleven sieves and a pan. The manner in which they are held insures their long life. Motor drive is equipped with two speed pulley and may therefore be used on either 50 or 60-cycle 110 volt. A.C. single phase current. Motor can also be equipped with time switch at a slight additional cost. **R. V. Ward, CE 7-115, 1515 W. Arrow Highway, Upland, Calif.**



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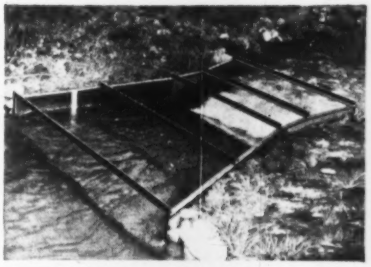

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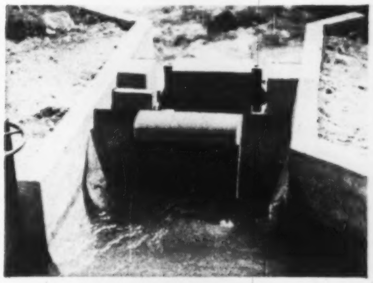

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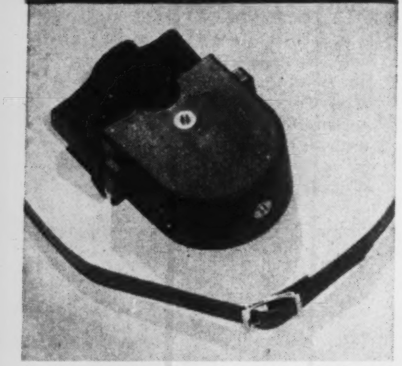

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Equipment, Materials & Methods (Continued)

Conveyor

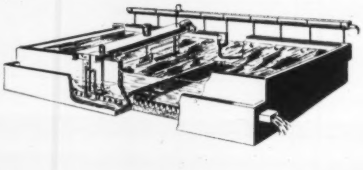
THE INTRODUCTION of the Bazooka, a portable trailer-type inclined screw conveyor for transferring cement from mill truck or railroad car to Wood cement tanker, or similar cement transports is announced. The Bazooka is 2-wheel mounted, rubber tired and powered by a gasoline engine. It is easily towed from one job to another. **Wood Manufacturing Co., P.O. Box 620, 6900 Tujunga Ave., North Hollywood, Calif.**

Asphalt Plank

EXCLUSIVE USE of Carey asphalt plank in the construction of the New York Port of Authority Bus Terminal has been announced. Carey elastite asphalt plank, a tough, rugged, board-like material, is used here as a protective cushioning for the waterproofing membrane under the roof-top parking area pavement. The product is made from high-melting asphalt, compounded with minerals for added wear and fibers for increased strength. In addition to its use as a protective cushioning, elastite asphalt plank is used as bridge flooring, in manufacturing plants, parking lots and loading docks. It is also specified for cold storage rooms to protect expensive insulation from mechanical damage. An outstanding feature of the plank is its light weight in comparison with other surface finishes. Thus, it provides protection from traffic wear without adding useless dead load to a structure. **The Philip Carey Mfg. Co., Dept. AP, Cincinnati 15, Ohio**

Sludge Controller

A SLUDGE CONTROLLER of the electrical transmission mechanical type has been introduced. Essentially, the 8-in. diameter squeeze controller is designed to control the flow of sludge or heavily laden liquids. The device overcomes most of the difficulties of regulating heavy viscous flows, even if corrosive, without affecting the moving parts of the controlling mechanism. Its flexible rubber section has no pockets or restrictions which could in any way trap particles of putrescent material since the unit is self-scouring. It can produce a condition of complete cutoff if necessary or of complete wide-open maximum flow conditions. The core of the device is a time-tested venturi tube with a throat section of flexible rubber. Differential pressure in the venturi is transmitted to a rate setter which measures and maintains the desired flow. If the flow tends to change, this meter actuates a motor-driven clamping device in the controller in order to adjust the flexible throat area. The unit measures the flow accurately and can be set over a wide control range. **Simplex Valve & Meter Company, CE 7-116, 68th and Upland Sts., Philadelphia 42, Pa**



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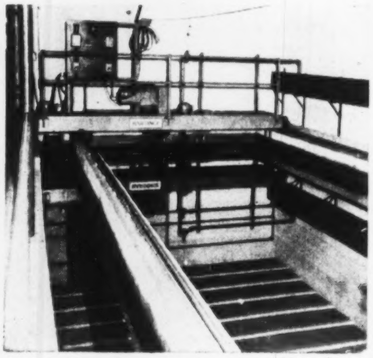

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Literature Available

CONCRETE MASONRY WALL CONSTRUCTION—A number of drawings illustrating various construction details for Concrete Masonry Units are assembled in a booklet. Construction details have been prepared in accordance with modular coordination of design. **The Waylite Company, CE 7-117, 105 W. Madison St., Chicago 2, Ill.**

PORTABLE STRAIN INDICATOR—Baldwin Bulletin 4103 describes an improved SR-4 portable strain indicator, the Type MA, with self contained AC power pack mounted inside the instrument case. **Baldwin-Lima-Hamilton Corp., CE 7-117, Philadelphia 42, Pa.**

SURVEY ON RUBBER ROADS—An independent survey of highway officials and engineers all over the country to find out what they thought of rubber roads has been conducted. Answers from one in every fifteen officials, covering 47 states, would seem to indicate they think rubber roads very much a permanent part of the future highway scene. Copy of the complete survey is available. **Natural Rubber Bureau, CE 7-117, 1631 K St., N. W., Washington 6, D. C.**

DOZERS—A catalog showing the 15 models of cable and hydraulic dozers and 3 models of control units available for Allis-Chalmers tractors has just been announced. It is extensively illustrated with cut-aways, engineering drawings, detailed and on-the-job photographs. It shows what has been designed into Gar Wood dozers and cable control units, and why, to help equipment owners move the greatest amount of material with their dozers and control units at the lowest possible cost. Ask for Form No. F-165. **Customer Service Dept., CE 7-117, Gar Wood Industries, Inc., Wayne, Mich.**

CONCRETE JOINTS—A 24-page fully illustrated and technical booklet discusses poured, premolded, ribbon and vibrated joints for concrete highways and airports. The booklet shows how modern mechanization methods make it possible to do a better job, faster, at much lower costs. Ask for Bulletin M-102. **Flexible Road Joint Machine Company, CE 7-117, Warren, Ohio**

LABORATORY APPARATUS—A 72-page catalog recently published, describes and illustrates over 800 items of apparatus for engineering tests of soils, concrete and bituminous materials. The extensive soil testing equipment section of the catalog presents information on Triaxial, Consolidation, California Bearing Ratio, Compaction, Pore Pressure, and all of the standard apparatus for field and laboratory engineering tests of soils. A special section is devoted to apparatus for chemical and agricultural tests of soils. Also included are sections on general laboratory apparatus, ovens, scales, mixing machines and laboratory furniture. Write for Catalog No. 53. **Soiltest, Inc., CE 7-117, 4520 W. North Ave., Chicago 39, Ill.**

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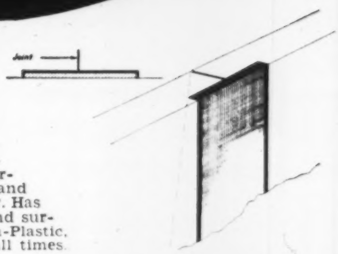

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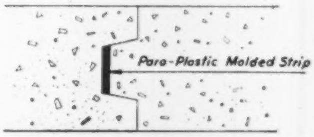

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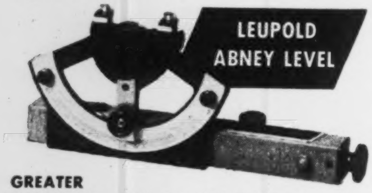

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Literature Available (Continued)

Maintenance Guide—Another in a series of cartoon-type instruction booklets for the company's equipment is available. The latest publication illustrates the proper operation and care required for Caterpillar's four large V-type engines—the D397, D386, D375 and D364. **Caterpillar Tractor Co., CE 7-118, Peoria, Ill.**

Modern Scaffolding—Aluminum sectional scaffolding, the modern scaffolding with new handling and safety features, is described and illustrated in a folder just published. The folder contains information about both ladder and rolling types of sections, pictures of on-the-job applications, specifications and illustrations of some of the structures possible with the various sections. Ask for Bulletin AS-2. **The Patent Scaffolding Company, Inc., CE 7-118, 38-21 12th St., Long Island City 1, N. Y.**

Plastiment Booklet—The theory and practice of obtaining a good concrete is the subject of a booklet, "Plastiment Concrete Densifier". Beginning with the gel mechanics of cement-water reaction, the booklet discusses the factors affecting cement hydration and basic quality of concrete, and how these factors can be controlled to reduce cracking and increase concrete hardness and impermeability. The booklet covers 8 pages of engineering information, illustrated with drawings, tests, photographs and descriptions of outstanding engineering projects constructed with Plastiment concrete. **Sika Chemical Corporation, CE 7-118, 35 Gregory Ave., Passaic, N. J.**

Drafting—A 143-page text entitled, "Drafting by the Model Method" is available. It is a complete course in drafting which employs an entirely new method of instruction, the model method. Cut-out, 3-dimensional models accompany the fully illustrated text in which every word, line, and drawing has been planned as an essential step in training competent draftsmen. Price is $3.50 paper; $5.00 cloth. **Arco Publishing Company, CE 7-118, 480 Lexington Ave., New York 17, N. Y.**

Water Control Apparatus—Over a year in the making, a 250-page, 8½ in. × 11 in. comprehensive catalog shows the full scope of Rodney Hunt water control apparatus. It consists of eight sections; sluice gates, timber gates, hoists, fabricated gates, racks and rakes, valves, engineering data. Included are hundreds of diagrams, photographs with detailed descriptions, and specifications. The catalog is printed in color and attractively bound in a permanent hard cover. The catalog is offered without obligation, but only to consulting engineers, contractors and others actively engaged in water control construction work. Requests must be made on business or official letterheads, stating title and position. Write for Catalog WCA952. **Rodney Hunt Machine Company, CE 7-118, 7 Water St., Orange, Mass.**

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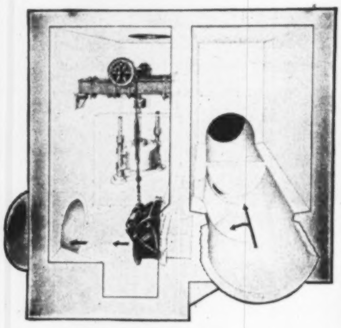

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

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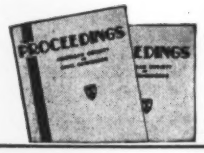

PROCEEDINGS AVAILABLE

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175. **Design of Side Walls in Chutes and Spillways,** by D. B. Gumensky.

D-121. Discussion of Paper, **Rate of Change of Grade per Station,** by Clarence J. Brownell.

D-127. Discussion of Paper, **Stresses in Deep Beams,** by Li Chow, Harry D. Conway, and George Winter.

176. **Advances in Sewage Treatment and Present Status of the Art: Progress Report of the Committee of the Sanitary Engineering Division on Sewerage and Sewage Treatment.**

177. **Earthquake Stresses in Shear Buildings,** by M. G. Salvadori.

178. **Rainfall Studies Using Rain-Gage Networks and Radar,** by H. E. Hudson, Jr., G. E. Stout, and F. A. Huff.

179. **Stiffness Charts for Gusseted Members Under Axial Load,** by John E. Goldberg.

180. **A Direct Step Method for Computing Water-Surface Profiles,** by Arthur A. Ezra.

D-123. Discussion of Paper, **Long-Period Waves or Surges in Harbors,** by John H. Carr.

D-126. Discussion of Paper, **Variation of Wind Velocity and Gusts with Height,** by R. H. Sherlock.

D-128. Discussion of Paper, **Horizontally Curved Box Beams,** by Charles E. Cutts.

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182. **Hipped Plate Analysis, Considering Joint Displacements,** by Ibrahim Gaafar.

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186. **Settling Rate of Suspensions in Solids Contact Units,** by A. A. Kalinske.

187. **The Equivalent Rectangle in Prestressed Concrete Design,** by John J. Peebles.

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D-136. Discussion of Paper, **Steady-State Forced Vibration of Continuous Frames,** by C. T. G. Looney.

189. **Snow Hydrology for Multiple-Purpose Reservoirs,** by H. S. Riesbol.

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193. **Velocity Measurement of Air-Water Mixtures,** by L. G. Straub, J. M. Killen, and O. P. Lamb.

D-129. Discussion of paper, **Analysis of Arch Dams of Variable Thickness,** by W. A. Perkins.

D-138. Discussion of paper, **The Value and Administration of a Zoning Plan,** by Huber Earl Smutz.

D-145. Discussion of paper, **Torsion of I-Type and H-Type Beams,** by John E. Goldberg.

194. **City Planning Techniques,** by Russell H. Riley.

195. **Special Procedures for Pavement Design,** by L. A. Palmer. The pavement extension and reinforcement program of the Bureau of Yards and Docks, United States Department of the Navy, is described in this paper. The unusual requirements imposed by modern aircraft have given rise to the establishment of new criteria and procedures. This paper offers the opportunity to study and discuss the results of the research and experience in pavement design and construction following an extensive program of airfield improvement.

196. **Recent Airport Design and Development,** by Philip A. Hahn. Recent developments and trends in airport design and construction are rather common knowledge to the engineer. This paper presents the reasons for these trends and developments. These

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advances have been based on engineering principles which are basically sound and economically wise. There is still another important factor which controls airport engineering—and that is the need for providing the necessary aeronautical requirements to assure the safe operation of aircraft in the vicinity of the airport, in turning zones or areas, in the approaches, and on the airport.

197. **Friction Factors for Turbulent Flow in Pipes,** by Edward F. Wilsey. Two formulas are developed for the evaluation of friction factors for turbulent flow in pipes. These formulas differ from the equations proposed by former experimenters in this field in that the author makes use of the hyperbolic cotangent of a function of the Reynolds number. The resulting expression is relatively simple when compared with equations that are in common usage in the field of hydraulics. All that is required to solve them is a set of mathematical tables.

198. **Live Loading for Long-Span Highway Bridges,** by R. J. Ivy, T. Y. Lin, Stewart Mitchell, N. C. Raab, V. J. Richey, and C. F. Scheffey. The selection of a suitable live loading for long spans has been left to the discretion of the designing engineer—in contrast to the standardization, in various codes, for short and medium spans. The authors present for study and discussion a loading to be used as a design standard, and a system of accompanying allowable unit stresses intended to provide for the economic design of long spans. The recommendations are based on studies involving actual highway vehicle weights and groupings.

199. **Plates with Boundary Conditions of Elastic Support,** by S. J. Fuchs. By use of a double Fourier series, the author obtains a solution for the reactions, deflections, and moments in a rectangular plate under transverse load. A specific problem is solved by use of the author's method of procedure—suitable curves are plotted, and experimental verification is offered. The paper is a concise presentation of an interesting method of approach to the solution of plate problems. The method of solution may be applied not only to transversely loaded plates but also to physical problems that involve harmonic or biharmonic differential equations.

D-134. Discussion of Paper, **Solution of an Hydraulic Problem by Analog Computer,** by R. E. Glover, D. J. Hebert, and C. R. Daum. The original paper, published in June 1952, described the general conditions of the problem of flow distribution in a network of estuarine channels to which an analog computer model was applied. Discussers are: J. van Veen; W. Douglas Baines; T. Blench; and R. E. Glover, D. J. Hebert, and C. R. Daum.

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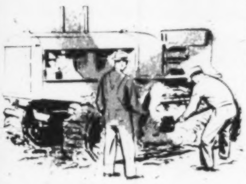
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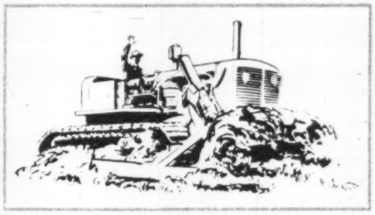
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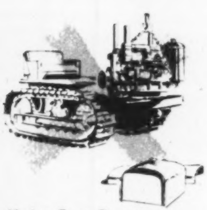
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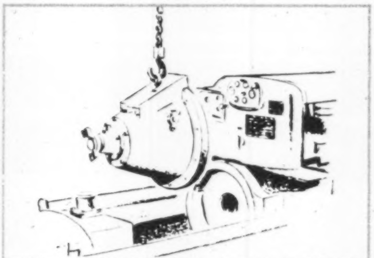
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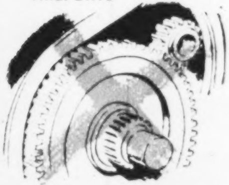
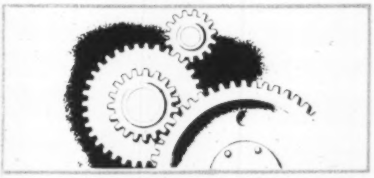
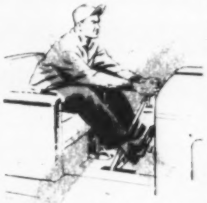
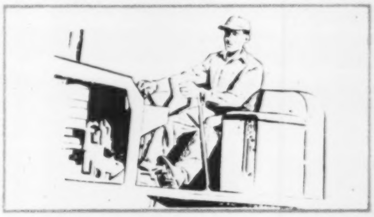
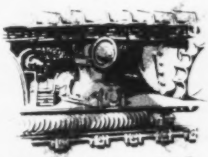
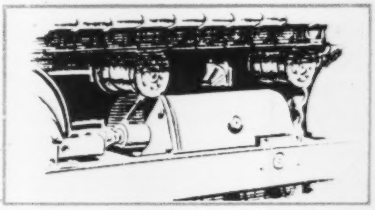

Single Reduction Final Drive

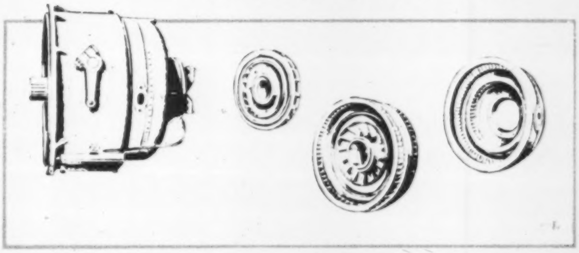

Double Reduction Final Drive. With smaller gears and shorter shafts, double reduction final drives provide better bearing and gear alignment. The "live" axle permits smaller, more serviceable seals. Equally important, double reduction drive provides for smooth, clean bottom construction and the extra ground clearance so necessary on rough terrain.


Ordinary Steering Clutches


Hydraulic Steering and Self-Energizing Brakes. The HD-15 and HD-20 have hydraulic booster steering; operator exerts only 3 to 5 lb. pressure on controls, so he gets small tractor maneuverability from these 27,850 and 41,000 crawlers. Self-energizing brakes need less pedal pressure, take hold with a firm, uniform grip.


Open or Partly Shielded Track Release Mechanism


Oil Enclosed Track Release Mechanism. Operating in oil and *sealed* against dirt and moisture, Allis-Chalmers track release mechanism seals out mud, ice and debris. Because it's completely sealed, release mechanism is in working condition at all times — providing positive protection when obstacles jam into the tracks.


Hydraulic Torque Converter Drive. The HD-20 is the only crawler tractor where torque converter is standard equipment and part of the basic design. Torque converter gives greater pay load capacity because this unit automatically balances travel speed to the load. And with most shifting eliminated, there's far less operator fatigue.

ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

ORIGINATOR OF THE
TORQUE CONVERTER TRACTOR

... a good pipeline

is the sum of good parts ...

Testing the compressive strength of a concrete cylinder

Testing the tensile strength of steel reinforcing wire

The finest design and the most accurate workmanship cannot result in a superior product *unless* the materials used are of the highest quality. That's why Lock Joint assures the excellence of each of its pipes by constantly testing both the finished product *and* the individual materials used.

• • •

In the Company's research and testing laboratory reinforcing steel is tested for tensile strength ... sand and aggregates are analyzed and classified ... specimens of concrete in daily use are tested for compressive strength ... gasket rubber undergoes varied and rigorous tests for elasticity and durability ... *all* ingredients are definitely proven before they are allowed to be put to use.

• • •

These carefully tested materials, together with Lock Joint's conservative design and precise workmanship, result in a finished product unexcelled in the pressure pipe field. If your project calls for pipe 16″ in diameter or larger, designed for pressures common to water works practice, specify Lock Joint Concrete Pressure Pipe—the pipe that's tested from start to finish and backed by nearly half a century of pipe manufacturing experience.

SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains 16″ in diameter or larger, as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.*

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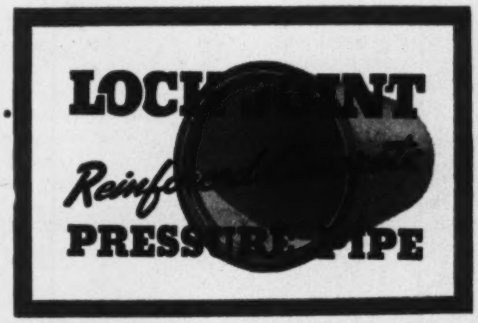PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich., Columbia, S. C.
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